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EXECUTIVE SUMMARY

ELEMENTAL COMPOSITION OF FINE AND COARSE PARTICLES COLLECTED IN ONTARIO HYDRO'S AIR AND PRECIPITATION MONITORING NETWORK

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Ontario Hydro operated an air and precipitation monitoring network in Ontario for a number of years as part of its acid rain research program. Dichotomous samplers, capable of segregating the aerosol into fine (< 2.5 μm diameter) and coarse (2.5-15 μm diameter) fractions, prior to collection on teflon filters, were used toward the end of the survey. Recent interests in trace element emissions from power plants, including ambient concentrations in the vicinity of the source, the potential for long-range transport and the possibility of using trace elements as convenient tracers of air mass origin, led to a preliminary investigation by Ontario Hydro and the Ontario Ministry of the Environment.

Aerosol samples collected in Ontario Hydro's network during February, 1983 were analyzed using energy dispersive x-ray fluorescence techniques, by the Ontario Ministry of the Environment. The results are presented in this report. Detectable concentrations of a number of trace elements (eg, Si, Ca, Fe, Se, As, V, Pb, Br, Cl) were found. An attempt was made to differentiate between elemental source types and natural and anthropogenic emissions, using the technique of element enrichment and by comparing natural and source emission ratios. Although a very limited data set was used, most of the elements encountered could be characterized into crustal or combustion-related groups. With a much larger data base and some improvement in sample handling, this technique might prove useful in monitoring regional concentrations or concentration patterns around a power plant, the latter in support of efforts to develop a model of the transport and deposition of trace elements and particulate matter.

job	file	date	report no.
740635-526-091	837.2331	November 19, 1984	84-360-K

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To Mr. F.J. Kee
Director of Research

ELEMENTAL COMPOSITION OF FINE AND COARSE PARTICLES COLLECTED IN ONTARIO HYDRO'S AIR AND PRECIPITATION MONITORING NETWORK

B. Handy

ABSTRACT

Seventy-four aerosol samples collected in Ontario Hydro's air and precipitation monitoring network were analyzed for trace elements using energy dispersive X-ray fluorescence. Measurable levels of the crustal elements Si, Ca, Fe and combustion related elements Se, As, V, Pb, Br and Cl were found.

1.0 INTRODUCTION

The Inorganic Trace Contaminant Section of the Ontario Ministry of the Environment analyzed for trace metals, seventy-four aerosol samples collected in Ontario Hydro's air and precipitation monitoring network from February 14 to 25, 1983. This report presents the results and discusses possible sources for the trace elements found.

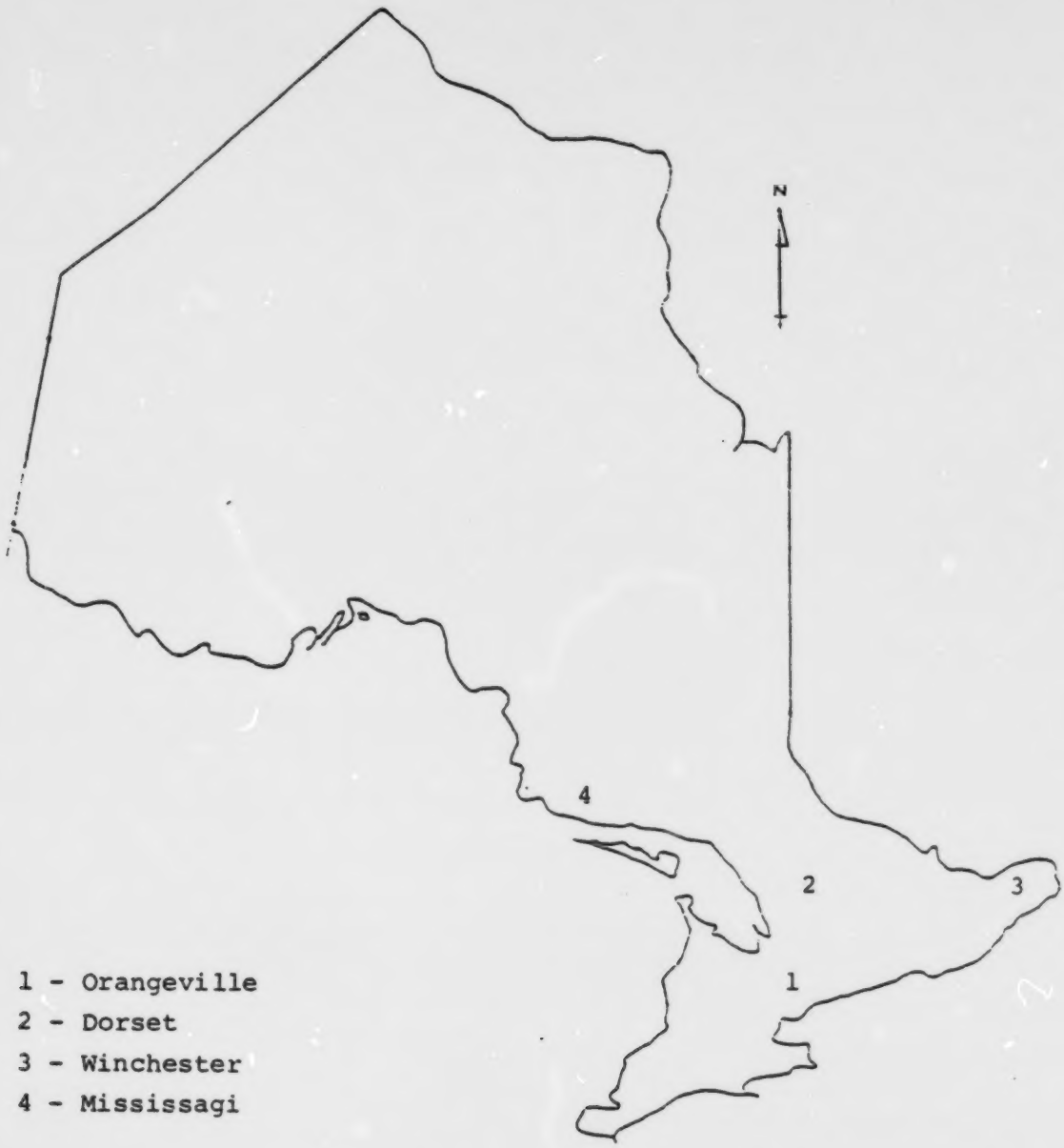
2.0 ONTARIO HYDRO SAMPLING NETWORK

Ontario Hydro operated an air and precipitation monitoring network from 1975 to May,1983. During February, 1983, four sampling locations were in operation (Figure 1), a detailed description of each site is presented in Appendix 1.

3.0 SAMPLE SELECTION

The Ontario Ministry of the Environment requested the fine and coarse particulate samples (ie, Teflon filters) collected with the dichotomous samplers that operated at each monitoring site during the latter half of February, 1983. A total of seventy-four samples, excluding blanks, covering the period February 14 to 25, 1983 were submitted.

job	file	date	report no.
740635-526-091	837.2331	November 19, 1984	84-360-K



1 - Orangeville
2 - Dorset
3 - Winchester
4 - Mississagi

FIGURE 1

LOCATION OF ONTARIO HYDRO
DICHOTOMOUS SAMPLERS, FEBRUARY, 1983

4.0 EXPERIMENTAL

4.1 Air Sampling

The air sampling system consisted of a modified Model 244 Sierra dichotomous sampler. It samples and size fractionates, by virtual impaction, particles into two size fractions - 2.5 to 15 micrometers (coarse, non-respirable) and less than 2.5 micrometers (fine, respirable). The fractionated air passed through a filter cassette on each air stream. The cassette on the fine particle stream contained a 37-mm dimeter, 1 µm pore size, Teflon filter for collection of non-volatile aerosol particles, followed by a 37-mm diameter, 1.1µm pore size, Nylon filter which collected volatile nitrates and nitric acid vapour. Both filters were in direct contact. The final filter was a 37-mm Whatman 41 cellulose filter impregnated with a potassium carbonate/glycerol solution which collected sulfur dioxide. This filter was separated from the Nylon and Teflon filters by a stainless steel screen. The cassette on the coarse particle stream contained a 37-mm diameter, 1 µm pore size, Teflon filter. To calculate a more accurate total nitrate, a Nylon filter was also added to this cassette towards the end of June, 1982.

The modified dichotomous sampler consists of a temperature-controlled chamber into which the control module and virtual impactor were constructed. Figure 2 illustrates such a unit. A more complete description can be found in Ontario Hydro Research Division Report No 82-484-K.

4.2 Sampling Procedures

Air sampling was carried out over 24-hour periods, five days per week, from about 0800 EST (DST) to 0800 EST (DST) of the following day, on Monday to Tuesday, Tuesday to Wednesday, Wednesday to Thursday, Thursday to Friday and Friday to Saturday.

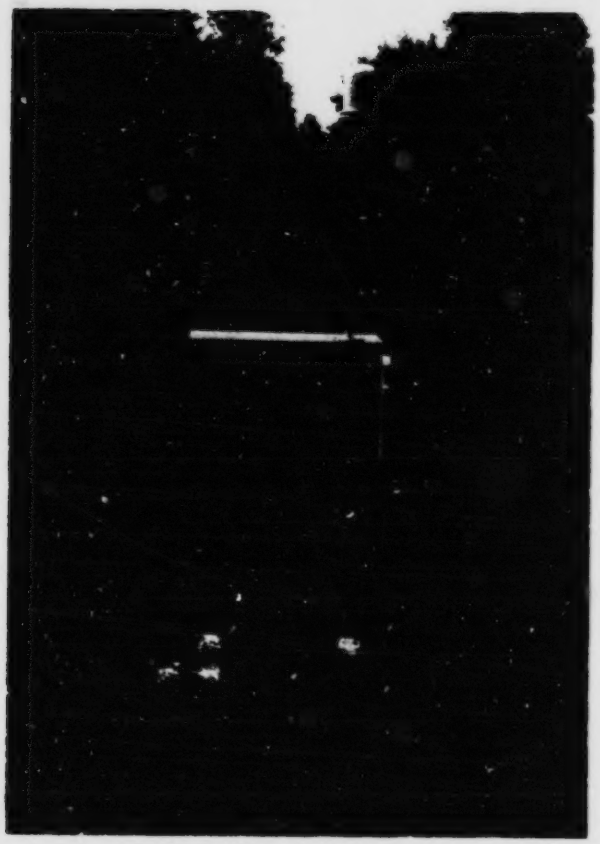
The collection protocol was as follows: at about 0800 EST (DST) each day the operator would check if the coarse and fine sample pressure and flow rates were normal, shut off the pump and record the elapsed sampling time. The filter cassettes were changed, the pump restarted and the flows checked. The exposed filter cassettes were placed in their original petri dishes, collected for two weeks and then transported to the Ontario Hydro Research laboratories. In the laboratory the cassettes were disassembled, the individual filters set into labelled petri dishes, sealed in plastic bags and stored at 4°C.

The particulate-containing Teflon filters were submitted for analysis to the Ontario Ministry of the Environment on March 30, 1983, but due to equipment failure were not analyzed until July, 1983.

5.0 CHEMICAL ANALYSIS

The samples submitted to the Ontario Ministry of the Environment were analyzed for trace elements using Energy Dispersive X-ray Fluorescence. The equipment used was an E.G.&G. ORTEC Model EEDS/TEFA2,

FIGURE 2



MODIFIED MODEL 244 SIERRA DICHOTOMOUS
SAMPLER AS OPERATED AT THE DORSET SITE

utilizing a molybdenum/tungsten lamp. Sample exposure was for between 100 and 200 seconds.

The filters were then returned to Ontario Hydro and analyzed for water extractable $SO_4^=$, NO_3^- and NH_4^+. A detailed description of the extraction and analysis techniques can be found in Ontario Hydro Research Division Report No 82-75-K.

6.0 METHOD OF DATA ANALYSIS

The results received from the Ontario Ministry of the Environment were in units of $\mu g/cm^2$ of filter area. The appropriate factors for total filter surface, sampling flow rate and time were then applied and the concentration of each element in $\mu g/m^3$ of air was calculated. An attempt was made to interpret the results. However, with such a small data set occurring over a very limited period, it is difficult to carry out a comprehensive statistical analysis. An alternative approach was required. This was dictated by our previous knowledge of trace element sources and concentrations.

Airborne trace elements may be of natural or man-made origin. Fossil-fuel combustion is the main man-made source. During the combustion process a multitude of elements are emitted into the atmosphere, but certain elements are associated with specific source types. High ambient levels of Vanadium, for example, are associated with residual oil combustion, whereas Selenium and Arsenic are high where coal combustion predominates.

The approach adopted here therefore, was to differentiate between natural and anthropogenic emissions, and to attempt to identify elemental source types. This was undertaken in two ways:

(a) Element Enrichment

This approach consists of looking at the relative enrichment of the elements as compared with their relative abundances in the surrounding rock and soil. A table of abundances published by Taylor (1964) was selected for this purpose and all elements were normalized by setting the Silicon equivalent to one. Other authors have chosen Aluminum as the normalizing element due to the increased sensitivity with EDXRF analysis. Aluminum was not used here because samples collected with Sierra Dichotomous Samplers are thought to be contaminated with Aluminum from the filter holder rings and from the large surface area of the sampler that the ambient air is in contact with before collection.

(b) Comparison of Natural and Source Emission Ratios

Here, selected elemental ratios were chosen and compared to the ratios from combustion sources (eg, coal, electric-arc steel production, residual oil, and automobile exhaust) and against the elemental ratios found in the surrounding rock and soil.

The other data analysis performed consisted of comparing the total sulfur values found by EDXRF analysis to the water extractable sulfate.

7.0 RESULTS

A summary of the meteorological conditions encountered from February 14 to 25, 1983 at each sampling location is listed in Table I.

The concentrations of trace elements in ambient air collected at the four sampling locations are listed in Appendix 2. The analysis report provided by the Ontario Ministry of the Environment specified that the uncertainties were derived from counting statistics and were an indication of precision only, not accuracy. Included in these tables is a comparison of the water extractable sulfate concentration to that of the sulfur (as $SO_4^=$) found by EDXRF.

The calculated elemental enrichment factors are presented in Appendix 3. Tables II through V present the comparison of ratios of ambient aerosol concentrations to source emission ratios.

8.0 DISCUSSION

As stated previously, airborne trace elements in the atmosphere are either of anthropogenic or earth crustal origin. Elements that are typically of earth crustal origin are Ca, Si, Al, Fe and Mn; S, V, Se, Pb and Cl are of fuel combustion origin. There are exceptions to these groupings, depending on source-receptor relationships.

Crustal Elements

Si, Ca and Fe, with other crustal elements, are predominantly coarse fraction elements. Between 60% and 79% of the Si and Ca mass was found in the coarse fraction at all sites.

Fe and Mn are crustal elements that are also emitted by industrial sources such as iron and steel mills. From the data in this study it appears that Fe is predominantly of crustal origin. This is illustrated in the Fe/Si ratios in Tables II to V. However, slight Fe enrichment does appear on certain days, especially with southerly air flow over the Province. Mn concentrations were relatively small during the study and predominated in the fine particulate fraction, indicating some degree of enrichment. This is also illustrated in the increased Mn/Si ratios of Tables II through V. Eimutis et al (1978) have estimated that 95% of North American anthropogenic Mn emissions are from the iron and steel industries.

Combustion Related Elements

Many trace elements emitted by combustion processes are volatile at combustion temperatures, eg, Se, As, V, Cl, etc. As combustion gases cool, condensation of volatile trace elements into fine respirable particles occurs. Natusch et al (1974) have found most combustion-related elements concentrated in fine fraction aerosol.

TABLE I

METEOROLOGICAL CONDITIONS FROM FEBRUARY 14 To 25, 1983 AT THE FOUR SAMPLING SITES

	Orangeville			Dorset			Winchester			Mississagi		
Date	WD	T	V	WD	T	V	WD	T	V	WD	T	V
14	250	2	H	270	1	H	250	2		280	1	F
15	350	3	FH	Calm	2	H	310	1	FH	350	1	
16	130	3	FH	150	2	FH	70	-2	FH	90	0	
17	280	0		260	1		250	0	H	240	-4	
18	140	1		150	-2		160	-5		140	-1	
21	280	2		240	1		202	0		220	-1	
22	105	0		140	-1		70	-2		120	-2	
23	310	1		290	1		280	1		320	-3	
24	350	-2		360	-3		310	-5		360	-9	
25	340	-6		330	-6		350	-7		310	-10	

WD - Mean Wind Direction

T - Mean Temperature ^{o}C

V - Obstruction to Visibility ‹9.6 km

H - Haze

F - Fog

METEOROLOGICAL STATIONS

Orangeville - Pearson International Airport YYZ
Dorset - Muskoka Airport YQA
Winchester - Ottawa International Airport YOW
Mississagi - Sault Ste Marie Airport SSM

TABLE II

COMPARISON OF THE RATIOS OF AMBIENT AEROSOL CONCENTRATIONS TO SOURCE EMISSION RATIOS

FEBRUARY, 1983

ORANGEVILLE

	Date										Source Emission Aerosol				
	14	15	16	17	18	21	22	23	24	25	Crustal Ratio	Coal Combustion	Electric-Arc Steel Production	Leaded Automobile Exhaust	Residual Oil Combustion
Fe/Si	0.19	0.23	0.36	A	A	0.26	0.31	0.33	0.19	0.15	0.20	0.33	6.3	3.3	2.4
Mn/Si	0.01	0.02	0.01	A	A	0.02	0.02	0.01	B	0.01	0.003	0.002	1.7	A	0.04
V/Six10^3	B	B	9	A	A	B	B	B	B	B	0.47	1.5	13	A	3 300
Se/Six10^4	B	B	45	A	A	99	B	B	B	B	0.002	21	B	A	B
Se/Sx10^4	B	B	75	A	A	20	B	B	B	B	1.9	0.17	B	A	B
Pb/Six10^3	58	228	249	A	A	99	424	58	65	113	0.04	0.46	150	280 000	84
Br/Pb	0.18	0.17	0.15	A	A	0.3	0.11	0.17	B	0.10	0.20	183	B	0.39	B
Cl/Pb	1.6	0.17	0.48	A	A	1.0	0.57	1.4	2.4	0.73	10	29 000	2.4	0.26	0.65
Cl/Si	0.09	0.04	0.12	A	A	0.1	0.24	0.08	0.15	0.08	0.0005	13	0.18	72	0.05

A - No Data

B - Below Detection Limit

REFERENCES:
- Crustal Ratios - Taylor (1964)
- Coal Combustion - Evans et al (1984)
- Electric-Arc Steel Production - Watson (1979)
- Leaded Automobile Exhaust - Harrison (1983)
- Residual Oil Combustion - Watson (1979)

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TABLE III

COMPARISON OF THE RATIOS OF AMBIENT AEROSOL CONCENTRATIONS TO SOURCE EMISSION RATIOS

FEBRUARY, 1983

DORSET

	Date										Source Emission Aerosol				
	14	15	16	17	18	21	22	23	24	25	Crustal Ratio	Coal Combustion	Electric-Arc Steel Production	Leaded Automobile Exhaust	Residual Oil Combustion
Fe/Si	0.22	0.65	0.20	0.26	0.18	0.47	0.34	0.24	0.35	0.22	0.20	0.33	6.3	3.3	2.4
Mn/Si	0.02	B	0.02	0.03	B	0.06	0.03	B	0.05	0.01	0.003	0.002	1.7	A	0.04
V/Six10^{3}	10	B	7.5	16	B	43	34	B	26	7.7	0.47	1.5	13	A	3 300
Se/Six10^{4}	121	1176	150	266	24	1064	847	597	519	116	0.002	21	B	A	B
Se/Sx10^{4}	17	20	19	29	59	69	59	68	91	42	1.9	0.17	B	A	B
Pb/Six10^{3}	117	2471	98	144	130	617	475	209	247	277	0.04	0.46	150	280 000	84
Br/Pb	0.17	0.07	0.21	0.22	0.19	0.10	0.11	0.14	0.11	0.08	0.20	183	B	0.39	B
Cl/Pb	0.50	B	0.97	0.52	2.1	0.41	0.50	0.64	2.2	0.32	10	29 000	2.4	0.26	0.65
Cl/Si	0.06	B	0.10	0.07	0.28	0.26	0.24	0.13	0.53	0.09	0.0005	13	0.18	72	0.05

A - No Data

B - Below Detection Limit

REFERENCES:
Crustal Ratios - Taylor (1964)
Coal Combustion - Evans et al (1984)
Electric-Arc Steel Production - Watson (1979)
Leaded Automobile Exhaust - Harrison (1983)
Residual Oil Combustion - Watson (1979)

TABLE IV

COMPARISON OF THE RATIOS OF AMBIENT AEROSOL CONCENTRATIONS TO SOURCE EMISSION RATIOS

FEBRUARY, 1983

WINCHESTER

	Date										Source Emission Aerosol				
	14	15	16	17	18	21	22	23	24	25	Crustal Ratio	Coal Combustion	Electric-Arc Steel Production	Leaded Automobile Exhaust	Residual Oil Combustion
Fe/Si	A	0.17	0.22	0.25	0.18	0.22	0.11	0.21	0.13	0.13	0.20	0.33	6.3	3.3	2.4
Mn/Si	A	0.03	0.03	0.02	0.02	0.01	0.04	0.03	0.01	0.01	0.003	0.002	1.7	A	0.04
V/Sixl0^{3}	A	38	38	20	10	9.9	7.6	34	14	7.4	0.47	1.5	13	A	3 300
Se/Sixl0^{4}	A	75	25	B	18	B	B	B	B	B	0.002	21	B	A	B
Se/Sxl0^{4}	A	8.8	9.8	B	18	B	B	B	B	B	1.9	0.17	B	A	B
Pb/Sixl0^{3}	A	376	140	246	93	148	66	348	133	105	0.04	0.46	150	280 000	84
Br/Pb	A	0.25	0.18	0.15	0.21	0.20	0.20	0.21	0.15	0.19	0.20	183	B	0.39	B
Cl/Pb	A	0.43	4.7	B	11	3.4	2.9	B	4.3	1.9	10	29 000	2.4	0.26	0.65
Cl/Si	A	0.16	0.65	B	1.1	0.51	0.19	B	0.58	0.23	0.0005	13	0.18	72	0.05

A - No Data

B - Below Detection Limit

REFERENCES:
- Crustal Ratios - Taylor (1964)
- Coal Combustion - Evans et al (1984)
- Electric-Arc Steel Production - Watson (1979)
- Leaded Automobile Exhaust - Harrison (1983)
- Residual Oil Combustion - Watson (1979)

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TABLE V

COMPARISON OF THE RATIOS OF AMBIENT AEROSOL CONCENTRATIONS TO SOURCE EMISSION RATIOS

FEBRUARY, 1983

MISSISSAGI

	Date										Source Emission Aerosol				
	14	15	16	17	18	21	22	23	24	25	Crustal Ratio	Coal Combustion	Electric-Arc Steel Production	Leaded Automobile Exhaust	Residual Oil Combustion
Fe/Si	0.18	0.04	A	B	0.20	0.08	0.48	0.14	0.32	0.16	0.20	0.33	6.3	3.3	2.4
Mn/Si	B	B	A	B	0.02	B	B	B	B	B	0.003	0.002	1.7	A	0.04
V/Six10^{3}	B	B	A	B	B	B	B	B	B	B	0.47	1.5	13	A	3 300
Se/Six10^{4}	B	B	A	B	150	B	500	319	B	B	0.002	21	B	A	B
Se/Sx10^{4}	B	B	A	B	77	B	49	50	B	B	1.9	0.17	B	A	B
Pb/Six10^{3}	84	B	A	107	233	172	325	181	170	96	0.04	0.46	150	280 000	84
Br/Pb	0.15	B	A	B	0.06	0.13	B	B	0.43	B	0.20	183	B	0.39	B
Cl/Pb	B	B	A	1.5	0.29	B	B	0.35	B	B	10	29 000	2.4	0.26	0.65
Cl/Si	B	B	A	0.16	0.07	B	B	0.06	B	B	0.0005	13	0.18	72	0.05

A - No Data

B - Below Detection Limit

REFERENCES:
- Crustal Ratios - Taylor (1964)
- Coal Combustion - Evans et al (1984)
- Electric-Arc Steel Production - Watson (1979)
- Leaded Automobile Exhaust - Harrison (1983)
- Residual Oil Combustion - Watson (1979)

Selenium

Ambient concentrations of Se collected during this study were confined entirely to the fine aerosol fraction. This has also been found by Spengler et al (1983) using Beckman dichotomous samplers in the US. The Enrichment Factor data in Appendix 3 indicate strong enrichment of this element. This is also illustrated by the Se ratio data in Tables II to V. The largest source of Se emission to the atmosphere is coal combustion and has been estimated by Eimutis et al (1978) to account for 60 to 85% of anthropogenic emissions, the rest being associated with iron smelter operations.

Sulfur

S is emitted to the atmosphere as gaseous SO_2. With long-range transport, particulate sulfate (eg, ammonium sulfate) may be the dominant sulfur species. The enrichment factor is high for S at all sites and 90% occurs as fine particulate. The Se/S ratios are higher than expected for coal combustion. This has also been found by Spengler et al (1983) who postulated that secondary sulfate formation may not benefit enough for fine particulate S to be correlated with the Se emissions.

Lead/Bromine

Pb and Br are primarily emitted to the atmosphere from leaded gasoline combustion. Although the observed ratio of Br to Pb is consistent with earth crustal ratios, the very large enrichment relative to Si convincingly implicate automotive exhaust as the major source of Pb and Br.

However, Harrison and Sturges (1983) have drawn attention to a number of problems asociated with using Br/Pb as an indicator of automotive lead pollution. Pb and Br are added to gasoline in approximately equal proportions and are emitted in the exhaust principally as PbBrCl, which reacts in the atmosphere to produce gaseous forms of Br such as HBr. These gaseous compounds are not quantitatively retained on filters, producing an apparent decline in the Br/Pb ethyl ratio of 0.39. Problems also arise with EDXRF analysis due to the volatile loss of Br from samples and standards during irradiation, and also during sample storage.

These problems can all lead to a masking of the non-automotive sources of Br and Pb.

9.0 CONCLUSIONS

Although this is a very limited data set, it has been seen that the dichotomous sampler is a useful tool for studying ambient trace metal concentrations. To provide more information on source/receptor relationships, a much larger data base would be required, with possibly air parcel trajectory calculations. The sample handling procedures would also require modification to adapt to the special requirements of EDXRF analysis. These improvements and additional data collection might be considered in connection with the ongoing effort, funded by

Technical and Training Services Division, to develop a model of the transport and deposition of trace elements and particulate matter.

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APPENDIX 1

MONITORING SITE DESCRIPTIONS AND LOCATIONS

(1) Orangeville

Located at Ontario Hydro Conference and Development Center on the Niagara Escarpment above the Hockley Valley, 8 km northeast of Orangeville. The monitoring station was located on the southern perimeter of the approximately 1 km^2 area. The surrounding area, in all directions is mostly open, grassy fields, with some low-level buildings to the north.

Mercator Coordinates:	4869200 mN; 577500 mE
Latitude and Longitude:	43° 58.4'; 80° 2.0'
Elevation:	419 m
Instrumentation:	(1) wet-only Sangamo precipitation collector
	(2) Modified Sierra dichotomous sampler
	(3) Weathertronics heated snow and rain gauge

Operated by: Ontario Hydro personnel.

(2) Dorset (Muskoka)

The Ontario Hydro sampling equipment was located at the Ontario Ministry of the Environment intercomparison site which is located approximately 2 km from Dorset along Highway 117. The instrumentation was located in the middle of approximately a 1 km^2 area covered by grass and low-level folliage. The surrounding area, in all directions, is wooded hills and bush.

Mercator coordinates:	5009600 mN; 662500 mE
Latitude and Longitude:	45° 13.5'; 78° 55.8'
Elevation:	320 m
Instrumentation:	(1) wet-only Sangamo precipitation collector
	(2) modified Sierra dichotomous sampler

Operated by: OME personnel.

(3) Winchester

This site was located in the backyard of a private residence adjacent to the Ontario Hydro Regional Office in Winchester. The monitoring equipment was on a grassy area (30 m x 40 m) surrounded by suburban residences on three sides and open fields on the other. Flat, agricultural land surrounds the town site. The village itself is approximately 1600 people with the Ontario Hydro Regional Office located on the southern edge.

Mercator Coordinates: 4992500 mN; 472400 mE

Latitude and Longitude: 45° 5.2'; 75° 21.1'

Elevation: 76 m

Instrumentation: (1) wet-only Sangamo precipitation collector

(2) modified Sierra dichotomous sampler

(3) Weathertronics heated snow and rain gauge

Operated by: Land owner (retired Ontario Hydro employee).

(4) Mississaqi

The site was located at Ontario Hydro's Mississagi Transformer Station, 0.5 km north of the Raynor Dam, 30 km northeast of the Town of Thessalon. The station was in an enclosed compound (140 m x 180 m) with a mixed gravel and pebble surface. The surrounding area is bush and rock. The monitoring equipment was located on a large open area (30 m x 40 m), south of the main transformer building.

Mercator Coordinates: 5144300 mN; 317200 mE

Latitude and Longitude: 46° 25.8'; 83° 22.8'

Elevation: 229 m

Instrumentation: (1) wet-only Sangamo precipitation collector

(2) Modified Sierra dichotomous sampler

Operated by: Ontario Hydro personnel.

APPENDIX 2

TRACE ELEMENT CONCENTRATIONS IN AMBIENT AIR COLLECTED AT ONTARIO HYDRO SAMPLING SITES, FEBRUARY 14 to 25, 1983

AIR CONCENTRATIONS

(ng/M**3)

1983.02.14 ORANGEVILLE

ELEMENT	FINE FRACTION (<2.5 um)	COARSE FRACTION (2.5-15 um)	ELEMENT	FINE FRACTION (<2.5 um)	COARSE FRACTION (2.5-15 um)
Al	.188±.014	.186±.013	Ni	ND	ND
Si	.192±.012	.292±.017	Cu	ND	ND
P	.090±.018	.013±.003	Zn	.041±.003	.007±.001
S	3.635±.192	.359±.024	As	.007±.004	ND
Cl	ND	.044±.007	Se	ND	ND
K	.052±.005	.020±.003	Br	.005±.002	ND
Ca	.015±.002	.238±.013	Rb	ND	ND
Ti	ND	.005±.001	Sr	ND	ND
V	ND	ND	Zr	ND	ND
Cr	ND	ND	Cd	ND	ND
Mn	.003±.001	ND	Ba	ND	ND
Fe	.036±.004	.054±.004	Pb	.028±.006	ND

	FINE	COARSE
SULPHATE(FROM EDXRF S ANALYSIS)	10.905	1.07%
SULPHATE(FROM WET ANALYSIS)	10.1	0.8%

ND - Not Detected

AIR CONCENTRATIONS

(ug/M**3)

1983.02.15 ORANGEVILLE

ELEMENT	FINE FRACTION (<2.5 um)	COARSE FRACTION (2.5-15 um)	ELEMENT	FINE FRACTION (<2.5 um)	COARSE FRACTION (2.5-15 um)
Al	.133±.012	.040±.007	Ni	ND	ND
Si	.161±.011	.102±.008	Cu	ND	ND
P	.093±.019	.012±.003	Zn	.018±.002	.004±.001
S	3.377±.179	.355±.023	As	ND	.007±.003
Cl	ND	.010±.006	Se	ND	ND
K	.070±.005	.006±.002	Br	.010±.002	ND
Ca	.013±.002	.034±.003	Rb	ND	ND
Ti	ND	.002±.001	Sr	ND	ND
V	ND	ND	Zr	ND	ND
Cr	ND	ND	Cd	ND	ND
Mn	.005±.001	ND	Ba	ND	ND
Fe	.034±.003	.026±.003	Pb	.060±.007	ND

	FINE	COARSE
SULPHATE(FROM EDXRF S ANALYSIS)	10.130	1.066
SULPHATE(FROM WET ANALYSIS)	9.7	0.88

ND - Not Detected

AIR CONCENTRATIONS

(ug/M**3)

1983.02.16 ORANGEVILLE

ELEMENT	FINE FRACTION (<2.5 um)	COARSE FRACTION (2.5-15 um)	ELEMENT	FINE FRACTION (<2.5 um)	COARSE FRACTION (2.5-15 um)
Al	.215±.017	.199±.015	Ni	ND	.003±.002
Si	.232±.015	.430±.024	Cu	ND	.003±.002
P	.097±.020	.026±.006	Zn	.049±.004	.017±.002
S	3.434±.184	.590±.036	As	ND	ND
Cl	ND	.080±.010	Se	.003±.002	ND
K	.054±.005	.027±.004	Br	.016±.002	.009±.002
Ca	.018±.003	.196±.011	Rb	ND	ND
Ti	.004±.001	.018±.002	Sr	ND	ND
V	.004±.001	.002±.001	Zr	ND	ND
Cr	ND	.003±.001	Cd	.025±.018	ND
Mn	.008±.001	.005±.001	Ba	ND	ND
Fe	.066±.005	.175±.010	Pb	.129±.011	.036±.006

	FINE	COARSE
SULPHATE(FROM EDXRF S ANALYSIS)	10.303	1.770
SULPHATE(FROM WET ANALYSIS)	9.9	1.4

ND Not Detected

AIR CONCENTRATIONS

(ug/M**3)

1983.02.21

ORANGEVILLE

ELEMENT	FINE FRACTION (<2.5 um)	COARSE FRACTION (2.5-15 um)	ELEMENT	FINE FRACTION (<2.5 um)	COARSE FRACTION (2.5-15 um)
Al	1.300±.069	ND	Ni	.004±.002	ND
Si	.083±.007	.119±.009	Cu	.003±.002	ND
P	.025±.006	ND	Zn	.013±.002	.005±.001
S	.907±.053	.097±.011	As	ND	.006±.003
Cl	.008±.007	.012±.005	Se	.002±.001	ND
K	.030±.004	.006±.002	Br	.006±.002	ND
Ca	.028±.003	.127±.007	Rb	ND	ND
Ti	.002±.001	ND	Sr	ND	ND
V	ND	ND	Zr	ND	ND
Cr	.002±.001	ND	Cd	ND	ND
Mn	.005±.001	ND	Ba	ND	ND
Fe	.029±.003	.024±.003	Pb	.020±.006	ND

	FINE	COARSE
SULPHATE(FROM EDXRF S ANALYSIS)	2.721	.292
SULPHATE(FROM WET ANALYSIS)	2.3	0.27

ND - Not Detected

AIR CONCENTRATIONS

(ug/M**3)

1983.02.22 ORANGEVILLE

ELEMENT	FINE FRACTION (<2.5 um)	COARSE FRACTION (2.5-15 um)	ELEMENT	FINE FRACTION (<2.5 um)	COARSE FRACTION (2.5-15 um)
Al	.060±.008	.124±.010	Ni	ND	ND
Si	.064±.007	.134±.009	Cu	ND	.004±.002
P	.041±.009	.006±.002	Zn	.037±.003	.012±.001
S	1.372±.077	.115±.012	As	.007±.004	ND
Cl	ND	.048±.007	Se	ND	ND
K	.025±.003	.004±.002	Br	.007±.002	.002±.001
Ca	.006±.002	.093±.006	Rb	ND	ND
Ti	ND	.006±.001	Sr	ND	ND
V	ND	ND	Zr	ND	ND
Cr	ND	ND	Cd	ND	ND
Mn	.003±.001	ND	Ba	ND	ND
Fe	.025±.003	.037±.003	Pb	.074±.008	.010±.004

	FINE	COARSE
SULPHATE(FROM EDXRF S ANALYSIS)	4.116	.346
SULPHATE(FROM WET ANALYSIS)	3.7	0.54

ND - Not Detected

AIR CONCENTRATIONS

(ug/M**3)

1983.02.23 ORANGEVILLE

ELEMENT	FINE FRACTION (<2.5 um)	COARSE FRACTION (2.5-15 um)	ELEMENT	FINE FRACTION (<2.5 um)	COARSE FRACTION (2.5-15 um)
Al	.056±.007	.096±.009	Ni	ND	ND
Si	.044±.005	.164±.010	Cu	ND	.002±.001
P	.016±.004	.003±.002	Zn	ND	ND
S	.593±.037	.043±.008	As	ND	ND
Cl	ND	.017±.005	Se	ND	ND
K	.012±.003	.014±.003	Br	.002±.001	ND
Ca	.012±.002	.222±.012	Rb	ND	ND
Ti	ND	ND	Sr	ND	ND
V	ND	ND	Zr	ND	ND
Cr	ND	ND	Cd	.019±.013	ND
Mn	.002±.001	ND	Ba	.237±.079	ND
Fe	.022±.003	.046±.003	Pb	.012±.005	ND

	FINE	COARSE
SULPHATE(FROM EDXRF S ANALYSIS)	1.780	.130
SULPHATE(FROM WET ANALYSIS)	1.5	<0.40

ND - Not Detected

AIR CONCENTRATIONS

(ug/M**3)

1983.02.24 ORANGEVILLE

ELEMENT	FINE FRACTION (<2.5 um)	COARSE FRACTION (2.5-15 um)	ELEMENT	FINE FRACTION (<2.5 um)	COARSE FRACTION (2.5-15 um)
Al	.083±.009	.027±.007	Ni	ND	ND
Si	.024±.005	.146±.010	Cu	ND	ND
P	.013±.003	ND	Zn	.011±.002	ND
S	.370±.027	.055±.009	As	ND	.006±.003
Cl	.008±.006	.018±.005	Se	ND	ND
K	.018±.003	.005±.003	Br	ND	ND
Ca	.024±.003	.178±.010	Rb	ND	ND
Ti	ND	ND	Sr	ND	ND
V	ND	ND	Zr	ND	ND
Cr	ND	ND	Cd	ND	ND
Mn	ND	ND	Ba	ND	ND
Fe	.011±.003	.021±.003	Pb	.011±.006	ND

	FINE	COARSE
SULPHATE(FROM EDXRF S ANALYSIS)	1.110	.166
SULPHATE(FROM WET ANALYSIS)	1.2	<0.40

ND - Not Detected

AIR CONCENTRATIONS

(ug/M**3)

1983.02.25 ORANGEVILLE

ELEMENT	FINE FRACTION (<2.5 um)	COARSE FRACTION (2.5-15 um)	ELEMENT	FINE FRACTION (<2.5 um)	COARSE FRACTION (2.5-15 um)
Al	.154±.012	.075±.008	Ni	ND	.002±.001
Si	.068±.006	.296±.017	Cu	ND	.003±.001
P	.018±.004	ND	Zn	.028±.002	.006±.001
S	.628±.039	.073±.009	As	.011±.004	ND
Cl	ND	.030±.006	Se	ND	ND
K	.018±.003	.023±.005	Br	.004±.001	ND
Ca	.024±.003	.392±.021	Rb	ND	ND
Ti	ND	.005±.001	Sr	ND	ND
V	ND	ND	Zr	.017±.014	.024±.013
Cr	ND	ND	Cd	ND	ND
Mn	.002±.001	ND	Ba	ND	ND
Fe	.011±.002	.045±.003	Pb	.036±.006	.005±.004

	FINE	COARSE
SULPHATE(FROM EDXRF S ANALYSIS)	1.883	.218
SULPHATE(FROM WET ANALYSIS)	1.6	0.52

ND - Not Detected

AIR CONCENTRATIONS

(ug/M**3)

1983.02.14 DORSET

ELEMENT	FINE FRACTION (<2.5 um)	COARSE FRACTION (2.5-15 um)	ELEMENT	FINE FRACTION (<2.5 um)	COARSE FRACTION (2.5-15 um)
Al	1.636±.086	.848±.046	Ni	.002±.001	.002±.001
Si	.161±.012	.334±.019	Cu	.005±.002	ND
P	.107±.022	.021±.005	Zn	.015±.002	.009±.001
S	3.057±.163	.507±.032	As	ND	.006±.003
Cl	ND	.029±.006	Se	.006±.001	ND
K	.058±.005	.021±.003	Br	.008±.002	.002±.001
Ca	.009±.002	.054±.004	Rb	ND	ND
Ti	.043±.003	.008±.001	Sr	.005±.002	ND
V	.005±.001	ND	Zr	.030±.016	ND
Cr	.005±.001	.002±.001	Cd	ND	.019±.013
Mn	.005±.001	.003±.001	Ba	ND	.141±.077
Fe	.053±.004	.057±.004	Pb	.053±.007	.005±.004

	FINE	COARSE
SULPHATE(FROM EDXRF S ANALYSIS)	9.172	1.521
SULPHATE(FROM WET ANALYSIS)	6.7	1.40

ND - Not Detected

AIR CONCENTRATIONS

(ug/M**3)

1983.02.15 DORSET

ELEMENT	FINE FRACTION (<2.5 um)	COARSE FRACTION (2.5-15 um)	ELEMENT	FINE FRACTION (<2.5 um)	COARSE FRACTION (2.5-15 um)
Al	.498±.029	.212±.015	Ni	.002±.001	ND
Si	ND	.017±.005	Cu	ND	ND
P	.034±.007	.004±.002	Zn	.014±.002	.013±.002
S	.926±.054	.086±.012	As	ND	.007±.003
Cl	ND	ND	Se	.002±.001	ND
K	.011±.003	ND	Br	.003±.002	ND
Ca	ND	ND	Rb	ND	ND
Ti	.012±.002	ND	Sr	ND	ND
V	ND	ND	Zr	ND	ND
Cr	ND	ND	Cd	ND	.017±.014
Mn	ND	ND	Ba	ND	.166±.083
Fe	.011±.003	ND	Pb	.042±.007	ND

	FINE	COARSE
SULPHATE(FROM EDXRF S ANALYSIS)	2.778	.259
SULPHATE(FROM WET ANALYSIS)	1.9	0.43

ND - Not Detected

AIR CONCENTRATIONS

(ug/M**3)

1983.02.16 DORSET

ELEMENT	FINE FRACTION (<2.5 um)	COARSE FRACTION (2.5-15 um)	ELEMENT	FINE FRACTION (<2.5 um)	COARSE FRACTION (2.5-15 um)
Al	.452±.027	.445±.026	Ni	.004±.002	ND
Si	.119±.011	.280±.016	Cu	.003±.002	ND
P	.102±.021	.012±.003	Zn	.014±.002	.005±.001
S	2.957±.158	.231±.018	As	ND	.005±.003
Cl	ND	.038±.006	Se	.006±.001	ND
K	.031±.004	.013±.003	Br	.000±.002	ND
Ca	.010±.002	.068±.004	Rb	ND	ND
Ti	.007±.001	.007±.001	Sr	ND	ND
V	.003±.001	ND	Zr	.039±.017	ND
Cr	ND	ND	Cd	.031±.017	ND
Mn	.004±.001	.002±.001	Ba	ND	.168±.078
Fe	.033±.003	.045±.004	Pb	.039±.006	ND

	FINE	COARSE
SULPHATE(FROM EDXRF S ANALYSIS)	8.872	.693
SULPHATE(FROM WET ANALYSIS)	8.1	0.59

ND - Not Detected

AIR CONCENTRATIONS

(ug/M**3)

1983.02.17 DORSET

ELEMENT	FINE FRACTION (<2.5 um)	COARSE FRACTION (2.5-15 um)	ELEMENT	FINE FRACTION (<2.5 um)	COARSE FRACTION (2.5-15 um)
Al	.445±.026	.645±.036	Ni	.003±.001	ND
Si	.051±.008	.137±.009	Cu	ND	ND
P	.045±.009	.014±.003	Zn	ND	ND
S	1.472±.082	.270±.020	As	ND	ND
Cl	ND	.014±.005	Se	.005±.001	ND
K	.013±.003	ND	Br	.006±.002	ND
Ca	.019±.002	.011±.002	Rb	.004±.002	.002±.001
Ti	.008±.001	.004±.001	Sr	.004±.002	.003±.002
V	.003±.001	ND	Zr	.067±.016	ND
Cr	ND	.002±.001	Cd	.020±.015	.029±.012
Mn	.004±.001	.002±.001	Ba	.090±.085	.130±.066
Fe	.030±.003	.019±.002	Pb	.027±.006	ND

	FINE	COARSE
SULPHATE(FROM EDXRF S ANALYSIS)	4.417	.809
SULPHATE(FROM WET ANALYSIS)	4.3	6:60

ND - Not Detected

AIR CONCENTRATIONS

(ug/M**3)

1983.02.18 DORSET

ELEMENT	FINE FRACTION (<2.5 um)	COARSE FRACTION (2.5-15 um)	ELEMENT	FINE FRACTION (<2.5 um)	COARSE FRACTION (2.5-15 um)
Al	.234±.016	.319±.020	Ni	ND	ND
Si	ND	.123±.009	Cu	ND	ND
P	.016±.004	.003±.002	Zn	ND	.003±.001
S	.483±.032	.027±.009	As	ND	ND
Cl	ND	.034±.006	Se	.003±.001	ND
K	.008±.003	ND	Br	.003±.002	ND
Ca	.003±.002	.077±.005	Rb	ND	ND
Ti	.002±.001	ND	Sr	ND	.003±.002
V	ND	ND	Zr	.059±.017	ND
Cr	ND	ND	Cd	ND	ND
Mn	ND	ND	Ba	.122±.094	.149±.073
Fe	.006±.002	.016±.002	Pb	.016±.006	ND

	FINE	COARSE
SULPHATE(FROM EDXRF S ANALYSIS)	1.449	.081
SULPHATE(FROM WET ANALYSIS)	1.2	<0.40

ND - Not Detected

AIR CONCENTRATIONS

(ug/M**3)

1983.02.21 DORSET

ELEMENT	FINE FRACTION (<2.5 um)	COARSE FRACTION (2.5-15 um)	ELEMENT	FINE FRACTION (<2.5 um)	COARSE FRACTION (2.5-15 um)
Al	.161±.013	.213±.015	Ni	.003±.001	ND
Si	ND	.047±.006	Cu	ND	ND
P	.027±.006	.006±.002	Zn	ND	.003±.001
S	.682±.042	.045±.010	As	ND	ND
Cl	ND	.012±.005	Se	.005±.001	ND
K	.006±.003	ND	Br	.003±.002	ND
Ca	ND	ND	Rb	.004±.002	ND
Ti	.008±.001	ND	Sr	ND	ND
V	.002±.001	ND	Zr	.071±.017	ND
Cr	.002±.001	ND	Cd	ND	.023±.014
Mn	.003±.001	ND	Ba	.348±.096	.279±.073
Fe	.013±.002	.009±.002	Pb	.029±.006	ND

	FINE	COARSE
SULPHATE(FROM EDXRF S ANALYSIS)	2.046	.136
SULPHATE(FROM WET ANALYSIS)	1.5	<0.40

ND - Not Detected

AIR CONCENTRATIONS

(ug/M**3)

1983.02.22 DORSET

ELEMENT	FINE FRACTION (<2.5 um)	COARSE FRACTION (2.5-15 um)	ELEMENT	FINE FRACTION (<2.5 um)	COARSE FRACTION (2.5-15 um)
Al	1.217±.065	.101±.009	Ni	.002±.001	ND
Si	ND	.059±.006	Cu	.005±.002	ND
P	.029±.006	.006±.002	Zn	.008±.002	.003±.001
S	.807±.048	.043±.009	As	ND	ND
Cl	ND	.014±.005	Se	.005±.001	ND
K	.012±.003	.004±.002	Br	.003±.001	.002±.001
Ca	.003±.002	.013±.002	Rb	ND	.003±.002
Ti	.026±.002	.002±.001	Sr	ND	.004±.002
V	.002±.001	ND	Zr	.006±.016	ND
Cr	.004±.001	ND	Cd	.023±.015	ND
Mn	.002±.001	ND	Ba	.095±.085	.191±.068
Fe	.015±.002	.005±.002	Pb	.028±.006	ND

	FINE	COARSE
SULPHATE(FROM EDXRF S ANALYSIS)	2.421	.129
SULPHATE(FROM WET ANALYSIS)	1.4	(0.40

ND - Not Detected

AIR CONCENTRATIONS

(ug/M**3)

1983.02.23 DORSET

ELEMENT	FINE FRACTION (<2.5 um)	COARSE FRACTION (2.5-15 um)	ELEMENT	FINE FRACTION (<2.5 um)	COARSE FRACTION (2.5-15 um)
Al	.511±.030	.326±.020	Ni	ND	ND
Si	ND	.067±.007	Cu	ND	ND
P	.020±.005	.004±.002	Zn	ND	.002±.001
S	.562±.036	.030±.009	As	ND	ND
Cl	ND	.009±.005	Se	.004±.001	ND
K	.006±.003	ND	Br	.002±.001	ND
Ca	.004±.002	.002±.001	Rb	ND	ND
Ti	.009±.001	.003±.001	Sr	ND	.004±.002
V	ND	ND	Zr	.059±.017	ND
Cr	.002±.001	ND	Cd	ND	.031±.014
Mn	ND	ND	Ba	ND	.217±.081
Fe	.013±.002	.003±.002	Pb	.014±.005	ND

	FINE	COARSE
SULPHATE(FROM EDXRF S ANALYSIS)	1.685	.091
SULPHATE(FROM WET ANALYSIS)	1.1	<0.40

ND - Not Detected

AIR CONCENTRATIONS

(ug/M**3)

1983.02.24 DORSET

ELEMENT	FINE FRACTION (<2.5 um)	COARSE FRACTION (2.5-15 um)	ELEMENT	FINE FRACTION (<2.5 um)	COARSE FRACTION (2.5-15 um)
Al	1.557±.082	.244±.016	Ni	.003±.001	ND
Si	ND	.077±.007	Cu	.005±.002	ND
P	.017±.004	.003±.002	Zn	.003±.002	.003±.001
S	.425±.029	.014±.008	As	ND	ND
Cl	.016±.006	.025±.005	Se	.004±.001	ND
K	.043±.005	ND	Br	.002±.001	ND
Ca	.004±.002	.005±.001	Rb	.004±.002	ND
Ti	.041±.003	ND	Sr	ND	.004±.002
V	.002±.001	ND	Zr	.056±.017	ND
Cr	.003±.001	ND	Cd	ND	ND
Mn	.002±.001	.002±.001	Ba	ND	ND
Fe	.015±.003	.012±.002	Pb	.019±.006	ND

	FINE	COARSE
SULPHATE(FROM EDXRF S ANALYSIS)	1.275	.043
SULPHATE(FROM WET ANALYSIS)	0.70	<0.40

ND Not Detected

AIR CONCENTRATIONS

(ug/M**3)

1983.02.25 DORSET

ELEMENT	FINE FRACTION (<2.5 um)	COARSE FRACTION (2.5-15 um)	ELEMENT	FINE FRACTION (<2.5 um)	COARSE FRACTION (2.5-15 um)
Al	.556±.032	.388±.023	Ni	ND	ND
Si	.025±.008	.234±.014	Cu	ND	ND
P	.023±.005	.008±.002	Zn	.034±.003	.010±.001
S	.667±.041	.047±.010	As	.006±.004	ND
Cl	ND	.023±.005	Se	.003±.001	ND
K	.028±.004	.007±.002	Br	.006±.002	ND
Ca	.013±.002	.014±.002	Rb	ND	.003±.002
Ti	.017±.002	.004±.001	Sr	ND	ND
V	.002±.001	ND	Zr	.060±.017	ND
Cr	ND	ND	Cd	ND	.015±.013
Mn	.003±.001	ND	Ba	ND	ND
Fe	.021±.003	.035±.003	Pb	.064±.007	.007±.004

	FINE	COARSE
SULPHATE(FROM EDXRF S ANALYSIS)	2.000	.141
SULPHATE(FROM WET ANALYSIS)	1.2	<0.40

ND - Not Detected

AIR CONCENTRATIONS

(ug/M**3)

1983.02.14 WINCHESTER

ELEMENT	FINE FRACTION (<2.5 um)	COARSE FRACTION (2.5-15 um)	ELEMENT	FINE FRACTION (<2.5 um)	COARSE FRACTION (2.5-15 um)
Al	.878±.049	.224±.016	Ni	ND	.004±.001
Si	.305±.018	.599±.032	Cu	.005±.002	.004±.001
P	.113±.023	.023±.005	Zn	.030±.003	.019±.002
S	3.413±.181	.353±.024	As	ND	ND
Cl	ND	.116±.011	Se	.005±.001	ND
K	.087±.006	.038±.004	Br	.017±.002	.003±.001
Ca	.025±.003	.160±.009	Rb	.005±.002	ND
Ti	.007±.001	.014±.001	Sr	ND	ND
V	.004±.001	.002±.001	Zr	ND	.028±.015
Cr	.004±.001	ND	Cd	ND	ND
Mn	.007±.001	ND	Ba	.178±.096	ND
Fe	.068±.005	.127±.008	Pb	.077±.008	.008±.005

	FINE	COARSE
SULPHATE(FROM EDXRF S ANALYSIS)	10.240	1.060
SULPHATE(FROM WET ANALYSIS)	8.4	0.84

ND - Not Detected

AIR CONCENTRATIONS

(ug/M**3)

1983.02.15 WINCHESTER

ELEMENT	FINE FRACTION (<2.5 um)	COARSE FRACTION (2.5-15 um)	ELEMENT	FINE FRACTION (<2.5 um)	COARSE FRACTION (2.5-15 um)
Al	9.362±.475	ND	Ni	.004±.002	ND
Si	.241±.015	.025±.005	Cu	.018±.002	ND
P	.081±.017	ND	Zn	.013±.002	ND
S	2.253±.122	.032±.008	As	ND	.005±.003
Cl	.020±.010	.023±.005	Se	.002±.001	ND
K	.064±.006	.018±.003	Br	.025±.002	ND
Ca	.034±.003	.040±.003	Rb	.004±.002	ND
Ti	.024±.002	ND	Sr	ND	ND
V	.010±.001	ND	Zr	ND	ND
Cr	.007±.001	ND	Cd	.033±.018	ND
Mn	.008±.001	ND	Ba	.202±.103	ND
Fe	.038±.004	.006±.002	Pb	.100±.009	ND

	FINE	COARSE
SULPHATE(FROM EDXRF S ANALYSIS)	6.760	.097
SULPHATE(FROM WET ANALYSIS)	5.9	<0.40

ND - Not Detected

AIR CONCENTRATIONS

(ug/M**3)

1983.02.16 WINCHESTER

ELEMENT	FINE FRACTION (<2.5 um)	COARSE FRACTION (2.5-15 um)	ELEMENT	FINE FRACTION (<2.5 um)	COARSE FRACTION (2.5-15 um)
Al	.600±.035	.310±.020	Ni	.010±.002	.005±.001
Si	.431±.024	.793±.042	Cu	.009±.002	.004±.001
P	.112±.023	.030±.007	Zn	.042±.003	.031±.002
S	2.812±.151	.261±.019	As	ND	ND
Cl	ND	.799±.044	Se	.003±.001	ND
K	.145±.009	.090±.009	Br	.026±.002	.004±.001
Ca	.041±.004	.708±.037	Rb	.005±.002	ND
Ti	.012±.002	.036±.003	Sr	ND	ND
V	.032±.002	.014±.001	Zr	.029±.017	.014±.013
Cr	.003±.001	.002±.001	Ca	ND	ND
Mn	.014±.001	.024±.002	Ba	ND	ND
Fe	.072±.005	.193±.011	Pb	.152±.011	.019±.005

	FINE	COARSE
SULPHATE(FROM EDXRF S ANALYSIS)	8.436	.783
SULPHATE(FROM WET ANALYSIS)	7.4	<0.40

ND - Not Detected

AIR CONCENTRATIONS

(ug/M**3)

1983.02.17 WINCHESTER

ELEMENT	FINE FRACTION (<2.5 um)	COARSE FRACTION (2.5-15 um)	ELEMENT	FINE FRACTION (<2.5 um)	COARSE FRACTION (2.5-15 um)
Al	.278±.019	.162±.012	Ni	.004±.001	ND
Si	.142±.010	.102±.008	Cu	.004±.002	.003±.001
P	.079±.016	.005±.002	Zn	.013±.002	.003±.001
S	2.194±.119	.092±.010	As	ND	ND
Cl	ND	ND	Se	ND	ND
K	.053±.005	.010±.002	Br	.009±.002	ND
Ca	.012±.002	.048±.003	Rb	.003±.002	ND
Ti	.003±.001	ND	Sr	ND	ND
V	.005±.001	ND	Zr	.025±.016	.051±.012
Cr	.002±.001	ND	Cd	ND	ND
Mn	.004±.001	ND	Ba	.097±.004	ND
Fe	.033±.003	.027±.003	Pb	.060±.007	ND

	FINE	COARSE
SULPHATE(FROM EDXRF S ANALYSIS)	6.582	.275
SULPHATE(FROM WET ANALYSIS)	5.9	<0.40

ND - Not Detected

AIR CONCENTRATIONS

(ug/M**3)

1983.02.18

WINCHESTER

ELEMENT	FINE FRACTION (<2.5 um)	COARSE FRACTION (2.5-15 um)	ELEMENT	FINE FRACTION (<2.5 um)	COARSE FRACTION (2.5-15 um)
Al	.308±.020	.557±.032	Ni	.004±.002	.004±.001
Si	.187±.012	.912±.048	Cu	ND	.003±.001
P	.040±.009	.032±.007	Zn	.016±.002	.028±.002
S	.924±.054	.196±.016	As	ND	ND
Cl	.016±.007	1.140±.060	Se	.002±.001	ND
K	.090±.007	.087±.009	Br	.017±.002	.004±.001
Ca	.329±.003	.746±.038	Rb	ND	ND
Ti	.006±.001	.020±.002	Sr	.003±.002	ND
V	.008±.001	.003±.001	Zr	.049±.017	ND
Cr	.002±.001	ND	Cd	ND	ND
Mn	.008±.001	.018±.001	Ba	ND	ND
Fe	.025±.003	.168±.009	Pb	.077±.008	.025±.005

	FINE	COARSE
SULPHATE(FROM EDXRF S ANALYSIS)	2.773	.588
SULPHATE(FROM WLT ANALYSIS)	2.4	<0.40

ND - Not Detected

AIR CONCENTRATIONS

(ug/M**3)

1983.02.21

WINCHESTER

ELEMENT	FINE FRACTION (<2.5 um)	COARSE FRACTION (2.5-15 um)	ELEMENT	FINE FRACTION (<2.5 um)	COARSE FRACTION (2.5-15 um)
Al	4.029±.207	ND	Ni	.005±.002	ND
Si	.160±.011	.245±.015	Cu	.012±.002	ND
P	.059±.012	.007±.002	Zn	.016±.002	.009±.001
S	1.454±.081	.065±.009	As	ND	ND
Cl	.015±.008	.191±.013	Se	ND	ND
K	.062±.005	.026±.003	Br	.012±.002	ND
Ca	.025±.003	.140±.008	Rb	.003±.002	ND
Ti	.014±.002	.003±.001	Sr	ND	ND
V	.004±.001	ND	Zr	.053±.016	.046±.013
Cr	.006±.001	ND	Cd	ND	ND
Mn	.004±.001	ND	Ba	.290±.088	ND
Fe	.032±.003	.056±.004	Pb	.060±.007	ND

	FINE	COARSE
SULPHATE(FROM EDXRF S ANALYSIS)	4.361	.194
SULPHATE(FROM WET ANALYSIS)	3.7	<0.40

ND - Not Detected

AIR CONCENTRATIONS

(ug/M**3)

1983.02.22

WINCHESTER

ELEMENT	FINE FRACTION (<2.5 um)	COARSE FRACTION (2.5-15 um)	ELEMENT	FINE FRACTION (<2.5 um)	COARSE FRACTION (2.5-15 um)
Al	7.936±.403	ND	Ni	.006±.002	.003±.001
Si	.665±.036	.652±.035	Cu	.023±.002	ND
P	.063±.013	.014±.004	Zn	.026±.002	.009±.001
S	1.597±.089	.098±.011	As	ND	ND
Cl	.030±.008	.224±.014	Se	ND	ND
K	.119±.008	.083±.007	Br	.014±.002	.003±.001
Ca	.036±.003	.402±.021	Rb	.003±.002	ND
Ti	.025±.002	.011±.001	Sr	ND	ND
V	.010±.001	ND	Zr	.040±.016	.039±.013
Cr	.010±.001	ND	Cd	ND	ND
Mn	.028±.002	.026±.002	Ba	ND	.087±.076
Fe	.054±.004	.095±.006	Pb	.078±.007	.009±.004

	FINE	COARSE
SULPHATE(FROM EDXRF S ANALYSIS)	4.792	.295
SULPHATE(FROM WET ANALYSIS)	3.7	<0.40

ND = Not Detected

AIR CONCENTRATIONS

(ug/M**3)

1983.02.23 WINCHESTER

ELEMENT	FINE FRACTION (<2.5 um)	COARSE FRACTION (2.5-15 um)	ELEMENT	FINE FRACTION (<2.5 um)	COARSE FRACTION (2.5-15 um)
Al	1.278±.068	ND	Ni	.005±.002	.003±.001
Si	.178±.012	ND	Cu	.006±.002	.002±.001
P	.047±.010	ND	Zn	.008±.002	ND
S	1.197±.060	ND	As	ND	ND
Cl	ND	ND	Se	ND	ND
K	.051±.005	.007±.002	Br	.011±.002	.002±.001
Ca	.008±.002	.024±.002	Rb	.004±.002	ND
Ti	.005±.001	ND	Sr	.004±.002	ND
V	.006±.001	ND	Zr	.029±.016	.019±.013
Cr	.003±.001	ND	Cd	ND	ND
Mn	.006±.001	ND	Ba	.114±.087	ND
Fe	.022±.003	.016±.002	Pb	.062±.007	ND

	FINE	COARSE
SULPHATE(FROM EDXRF S ANALYSIS)	3.590	0.000
SULPHATE(FROM WET ANALYSIS)	3.0	<0.40

ND - Not Detected

AIR CONCENTRATIONS

(ug/M**3)

1983.02.24 WINCHESTER

ELEMENT	FINE FRACTION (<2.5 um)	COARSE FRACTION (2.5-15 um)	ELEMENT	FINE FRACTION (<2.5 um)	COARSE FRACTION (2.5-15 um)
Al	.761±.042	.466±.027	Ni	.004±.002	.004±.001
Si	.079±.007	.484±.027	Cu	.004±.002	.003±.001
P	.029±.006	.011±.003	Zn	.023±.002	.006±.001
S	.771±.047	.099±.011	As	ND	ND
Cl	.012±.006	.312±.019	Se	ND	ND
K	.064±.005	.037±.005	Br	.011±.002	ND
Ca	.019±.002	.368±.019	Rb	ND	ND
Ti	.009±.001	.007±.001	Sr	ND	ND
V	.006±.001	.002±.001	Zr	ND	.044±.015
Cr	.003±.001	ND	Cd	ND	ND
Mn	.004±.001	.002±.001	Ba	ND	ND
Fe	.015±.003	.060±.004	Pb	.067±.007	.008±.004

	FINE	COARSE
SULPHATE(FROM EDXRF S ANALYSIS)	2.313	.298
SULPHATE(FROM WET ANALYSIS)	1.8	<0.40

ND -- Not Detected

AIR CONCENTRATIONS

(ug/M**3)

1983.02.25 WINCHESTER

ELLMENT	FINE FRACTION (<2.5 um)	COARSE FRACTION (2.5-15 um)	ELEMENT	FINE FRACTION (<2.5 um)	COARSE FRACTION (2.5-15 um)
Al	.331±.021	.203±.014	Ni	.002±.001	ND
Si	.103±.008	.439±.024	Cu	.003±.002	.003±.001
P	.037±.008	.005±.002	Zn	.007±.002	ND
S	.661±.041	.048±.009	As	ND	ND
Cl	ND	.123±.010	Se	ND	ND
K	.051±.005	.032±.004	Br	.012±.002	ND
Ca	.021±.002	.273±.015	Rb	.003±.002	ND
Ti	.005±.001	.006±.001	Sr	ND	ND
V	.004±.001	ND	Zr	ND	.042±.014
Cr	.002±.001	ND	Cd	ND	ND
Mn	.004±.001	ND	Ba	ND	ND
Fe	.013±.002	.056±.004	Pb	.057±.007	.007±.004

	FINE	COARSE
SULPHATE(FROM EDXRF S ANALYSIS)	1.902	.144
SULPHATE(FROM WET ANALYSIS)	1.5	<0.40

ND - Not Detected

AIR CONCENTRATIONS

(ug/M**3)

1983.02.14 MISSISSAGI

ELEMENT	FINE FRACTION (<2.5 um)	COARSE FRACTION (2.5-15 um)	ELEMENT	FINE FRACTION (<2.5 um)	COARSE FRACTION (2.5-15 um)
Al	.075±.009	.159±.013	Ni	ND	ND
Si	.103±.008	.134±.009	Cu	ND	ND
P	.053±.011	.013±.003	Zn	.013±.002	.003±.001
S	1.780±.098	.259±.019	As	ND	ND
Cl	ND	ND	Se	ND	ND
K	.055±.005	.007±.002	Br	.003±.002	ND
Ca	.010±.002	.016±.002	Rb	.003±.002	ND
Ti	.004±.001	.002±.001	Sr	ND	ND
V	ND	ND	Zr	ND	ND
Cr	ND	ND	Cd	ND	.025±.013
Mn	ND	ND	Ba	.118±.089	ND
Fe	.027±.003	.016±.002	Pb	.012±.006	.008±.004

	FINE	COARSE
SULPHATE(FROM EDXRF S ANALYSIS)	5.339	.776
SULPHATE(FROM WET ANALYSIS)	4.0	0.65

ND - Not Detected

AIR CONCENTRATIONS

(ug/M**3)

1983.02.15 MISSISSAGI

ELEMENT	FINE FRACTION (<2.5 um)	COARSE FRACTION (2.5-15 um)	ELEMENT	FINE FRACTION (<2.5 um)	COARSE FRACTION (2.5-15 um)
Al	.013±.008	.184±.014	Ni	ND	ND
Si	.019±.005	.063±.006	Cu	ND	ND
P	.008±.003	ND	Zn	ND	ND
S	.419±.029	.050±.009	As	.006±.003	ND
Cl	ND	ND	Se	ND	ND
K	.011±.003	ND	Br	ND	ND
Ca	ND	ND	Rb	ND	ND
Ti	.007±.001	ND	Sr	ND	ND
V	ND	ND	Zr	ND	ND
Cr	ND	ND	Cd	ND	.044±.014
Mn	ND	ND	Ba	.157±.095	.112±.074
Fe	ND	.003±.002	Pb	ND	ND

	FINE	COARSE
SULPHATE(FROM EDXRF S ANALYSIS)	1.257	.151
SULPHATE(FROM WET ANALYSIS)	1.1	<0.40

ND - Not Detected

AIR CONCENTRATIONS

(ug/M**3)

1986.02.17 MISSISSAGI

ELEMENT	FINE FRACTION (<2.5 um)	COARSE FRACTION (2.5-15 um)	ELEMENT	FINE FRACTION (<2.5 um)	COARSE FRACTION (2.5-15 um)
Al	.026±.008	.068±.009	Ni	ND	ND
Si	.028±.005	.028±.005	Cu	ND	ND
P	.012±.003	ND	Zn	.009±.002	.003±.001
S	.474±.031	.058±.010	As	ND	ND
Cl	.009±.006	ND	Se	ND	ND
K	.019±.003	ND	Br	ND	ND
Ca	.004±.002	ND	Rb	ND	ND
Ti	.002±.001	ND	Sr	ND	ND
V	ND	ND	Zr	ND	ND
Cr	ND	ND	Cd	ND	ND
Mn	ND	ND	Ba	.148±.092	ND
Fe	ND	ND	Pb	ND	.006±.005

	FINE	COARSE
SULPHATE(FROM EDXRF S ANALYSIS)	1.423	.174
SULPHATE(FROM WET ANALYSIS)	1.1	<0.40

ND - Not Detected

AIR CONCENTRATIONS

(ug/M**3)

1983.02.18 MISSISSAGI

ELEMENT	FINE FRACTION (<2.5 um)	COARSE FRACTION (2.5-15 um)	ELEMENT	FINE FRACTION (<2.5 um)	COARSE FRACTION (2.5-15 um)
Al	ND	.063±.009	Ni	ND	ND
Si	.005±.004	.128±.009	Cu	ND	ND
P	.004±.002	.013±.003	Zn	ND	.002±.001
S	.061±.011	.199±.016	As	ND	ND
Cl	.009±.005	ND	Se	.002±.001	ND
K	.003±.002	.007±.002	Br	.002±.001	.004±.001
Ca	ND	.044±.003	Rb	.003±.002	ND
Ti	ND	.004±.001	Sr	ND	ND
V	ND	ND	Zr	ND	.015±.014
Cr	.004±.001	ND	Cd	ND	.033±.012
Mn	ND	.002±.001	Ba	.333±.084	.187±.066
Fe	ND	.026±.003	Pb	.007±.005	.024±.004

	FINE	COARSE
SULPHATE(FROM EDXRF S ANALYSIS)	.184	.598
SULPHATE(FROM WET ANALYSIS)	<0.4	<0.40

ND - Not Detected

AIR CONCENTRATIONS

(ug/M**3)

1983.02.21 MISSISSAGI

ELEMENT	FINE FRACTION (<2.5 um)	COARSE FRACTION (2.5-15 um)	ELEMENT	FINE FRACTION (<2.5 um)	COARSE FRACTION (2.5-15 um)
Al	.067±.009	.062±.008	Ni	ND	ND
Si	.052±.006	.035±.005	Cu	ND	ND
P	.017±.004	.003±.002	Zn	ND	ND
S	.565±.036	.030±.008	As	ND	ND
Cl	ND	ND	Se	ND	ND
K	.020±.003	ND	Br	ND	.002±.001
Ca	ND	.005±.002	Rb	.004±.002	ND
Ti	.003±.001	ND	Sr	ND	ND
V	ND	ND	Zr	ND	ND
Cr	ND	ND	Cd	ND	.042±.013
Mn	ND	ND	Ba	ND	.031±.076
Fe	ND	.007±.002	Pb	.006±.005	.009±.004

	FINE	COARSE
SULPHATE(FROM EDXRF S ANALYSIS)	1.695	.091
SULPHATE(FROM WET ANALYSIS)	1.4	<0.40

ND = Not Detected

AIR CONCENTRATIONS

(ug/M**3)

1983.02.22 MISSISSAGI

ELEMENT	FINE FRACTION (<2.5 um)	COARSE FRACTION (2.5-15 um)	ELEMENT	FINE FRACTION (<2.5 um)	COARSE FRACTION (2.5-15 um)
Al	.016±.007	ND	Ni	ND	ND
Si	.034±.005	.006±.004	Cu	ND	ND
P	.012±.003	.005±.002	Zn	.002±.001	ND
S	.396±.027	.013±.007	As	ND	ND
Cl	ND	ND	Se	ND	.002±.001
K	.013±.003	ND	Br	ND	ND
Ca	ND	ND	Rb	ND	ND
Ti	.002±.001	.002±.001	Sr	ND	ND
V	ND	ND	Zr	.020±.017	.028±.013
Cr	ND	ND	Cd	ND	.031±.012
Mn	ND	ND	Ba	.124±.081	.204±.068
Fe	.019±.003	ND	Pb	ND	.013±.004

	FINE	COARSE
SULPHATE(FROM EDXRF S ANALYSIS)	1.188	.038
SULPHATE(FROM WET ANALYSIS)	1.1	<0.40

ND - Not Detected

AIR CONCENTRATIONS

(ug/M**3)

1983.02.23 MISSISSAGI

ELEMENT	FINE FRACTION (<2.5 um)	COARSE FRACTION (2.5-15 um)	ELEMENT	FINE FRACTION (<2.5 um)	COARSE FRACTION (2.5-15 um)
Al	.032±.007	.111±.010	Ni	ND	ND
Si	.048±.006	.046±.005	Cu	ND	ND
P	.018±.004	.008±.002	Zn	ND	ND
S	.567±.036	.034±.008	As	ND	ND
Cl	.006±.005	ND	Se	.003±.001	ND
K	.010±.002	ND	Br	ND	ND
Ca	ND	.005±.002	Rb	.003±.002	ND
Ti	.003±.001	.003±.001	Sr	ND	ND
V	ND	ND	Zr	.026±.016	.015±.013
Cr	ND	.012±.001	Cd	ND	.038±.012
Mn	ND	ND	Ba	.092±.079	.136±.066
Fe	.008±.002	.005±.002	Pb	.008±.005	.009±.004

	FINE	COARSE
SULPHATE(FROM EDXRF S ANALYSIS)	1.702	.103
SULPHATE(FROM WET ANALYSIS)	1.1	(0.40

ND - Not Detected

AIR CONCENTRATIONS

(ug/M**3)

1983.02.24 MISSISSAGI

ELEMENT	FINE FRACTION (<2.5 um)	COARSE FRACTION (2.5-15 um)	ELEMENT	FINE FRACTION (<2.5 um)	COARSE FRACTION (2.5-15 um)
Al	.016±.006	.010±.006	Ni	ND	ND
Si	.030±.005	.011±.004	Cu	ND	ND
P	.011±.003	.003±.002	Zn	ND	ND
S	.297±.022	ND	As	ND	ND
Cl	ND	ND	Se	ND	ND
K	.005±.002	ND	Br	.003±.001	ND
Ca	ND	ND	Rb	ND	ND
Ti	.002±.001	ND	Sr	ND	ND
V	ND	ND	Zr	ND	.029±.014
Cr	ND	ND	Cd	ND	.034±.012
Mn	ND	ND	Ba	.184±.079	ND
Fe	.013±.002	ND	Pb	ND	.007±.004

	FINE	COARSE
SULPHATE(FROM EDXRF S ANALYSIS)	.091	0.000
SULPHATE(FROM WET ANALYSIS)	0.91	<0.40

ND - Not Detected

AIR CONCENTRATIONS

(ug/M**3)

1983.02.25 MISSISSAGI

ELEMENT	FINE FRACTION (<2.5 um)	COARSE FRACTION (2.5-15 um)	ELEMENT	FINE FRACTION (<2.5 um)	COARSE FRACTION (2.5-15 um)
Al	.011±.007	.037±.007	Ni	ND	ND
Si	.028±.005	.129±.009	Cu	ND	ND
P	.006±.002	.005±.002	Zn	ND	ND
S	.246±.020	ND	As	ND	ND
Cl	ND	ND	Se	ND	ND
K	.011±.003	ND	Br	ND	ND
Ca	ND	.005±.002	Rb	ND	ND
Ti	.002±.001	ND	Sr	ND	ND
V	ND	ND	Zr	ND	ND
Cr	ND	ND	Cd	ND	.037±.012
Mn	ND	ND	Ba	.139±.082	ND
Fe	.014±.003	.011±.002	Pb	ND	.015±.005

	FINE	COARSE
SULPHATE(FROM EDXRF S ANALYSIS)	.737	0.000
SULPHATE(FROM WET ANALYSIS)	0.65	<0.40

ND - Not Detected

APPENDIX 3

ELEMENTAL ENRICHMENT FACTORS IN AMBIENT AIR COLLECTED AT ONTARIO HYDRO SAMPLING SITES, FEBRUARY 14 to 25, 1983

ENRICHMENT FACTORS RELATIVE TO EARTH CRUSTAL ABUNDANCES

NORMALIZING ELEMENT: Si

1983.02.14 ORANGEVILLE

ELEMENT	ENRICHMENT FACTOR		ELEMENT	ENRICHMENT FACTOR	
Al	2.6±	.2	Ni	ND	
Si	1.0±	.1	Cu	ND	
P	57.1±	11.9	Zn	403.2±	37.2
S	8952.9±	484.3	As	2249.7±	1268.2
Cl	199.4±	31.7	Se	ND	
K	2.0±	.2	Br	1205.5±	386.7
Ca	3.6±	.2	Rb	ND	
Ti	.5±	.1	Sr	ND	
V	ND		Zr	ND	
Cr	ND		Cd	ND	
Mn	1.6±	.5	Ba	ND	
Fe	.9±	.1	Pb	1267.7±	280.5

ND - Not Detected

ENRICHMENT FACTORS RELATIVE TO EARTH CRUSTAL ABUNDANCES

NORMALIZING ELEMENT: Si

1983.02.15 ORANGEVILLE

ELEMENT	ENRICHMENT FACTOR		ELEMENT	ENRICHMENT FACTOR	
Al	2.2±	.2	Ni	ND	
Si	1.0±	.1	Cu	ND	
P	107.5±	22.3	Zn	334.3±	49.1
S	15353.7±	832.6	As	4032.6±	1901.8
Cl	79.8±	47.4	Se	ND	
K	3.9±	.4	Br	4152.4±	752.5
Ca	1.2±	.1	Rb	ND	
Ti	.3±	.2	Sr	ND	
V	ND		Zr	ND	
Cr	ND		Ca	ND	
Mn	5.7±	.9	Ba	ND	
Fe	1.1±	.1	Pb	5050.1±	612.8

ND - Not Detected

ENRICHMENT FACTORS RELATIVE TO EARTH CRUSTAL ABUNDANCES

NORMALIZING ELEMENT: Si

1982.02.16 THANGEVILLE

ELEMENT	ENRICHMENT FACTOR		ELEMENT	ENRICHMENT FACTOR	
Al	2.1±	.2	Ni	16.7±	9.0
Cl	1.0±	.1	Cu	22.8±	14.3
P	49.5±	10.3	Zn	400.6±	34.2
S	6584.6±	360.1	As	ND	
Cl	261.1±	31.4	Se	27308.3±	13654.1
K	1.7±	.2	Br	4217.2±	647.9
Ca	2.2±	.1	Rb	ND	
Ti	1.6±	.2	Sr	ND	
V	17.9±	5.4	Zr	ND	
Cr	14.0±	4.1	Cd	53201.2±	37632.1
Mn	5.5±	.8	Ba	ND	
Fe	1.8±	.1	Pb	5485.2±	551.3

ND - Not Detected

ENRICHMENT FACTORS RELATIVE TO EARTH CRUSTAL ABUNDANCES

NORMALIZING ELEMENT: Si

1983.02.21 ORANGEVILLE

ELEMENT	ENRICHMENT FACTOR		ELEMENT	ENRICHMENT FACTOR	
Al	21.9±	1.2	Ni	66.1±	20.1
Si	1.0±	.1	Cu	65.1±	46.4
P	33.5±	7.4	Zn	359.5±	69.8
S	5390.2±	344.9	As	4809.0±	2312.8
Cl	223.7±	121.0	Se	43935.2±	35148.2
K	2.4±	.4	Br	3241.1±	883.0
Ca	5.2±	.3	Rb	ND	
Ti	.6±	.3	Sr	ND	
V	ND		Zr	ND	
Cr	21.1±	11.8	Cd	ND	
Mn	7.3±	1.2	Ba	ND	
Fe	1.3±	.1	Pb	2228.5±	613.7

ND - Not Detected

ENRICHMLNT FACTORS RELATIVE TO EARTH CRUSTAL ABUNDANCES

NORMALIZING ELEMENT: Si

1983.02.22 ORANGEVILLE

ELEMENT	ENRICHMENT FACTOR		ELEMENT	ENRICHMENT FACTOR	
Al	3.2±	.3	Ni	ND	
Si	1.0±	.1	Cu	109.0±	40.7
P	63.4±	14.3	Zn	989.7±	90.0
S	8163.4±	488.2	As	5531.3±	3612.3
Cl	523.9±	74.0	Se	ND	
K	2.0±	.4	Br	5327.5±	1572.3
Ca	3.4±	.3	Rb	ND	
Ti	1.4±	.3	Sr	ND	
V	ND		Zr	ND	
Cr	ND		Cd	ND	
Mn	4.3±	1.1	Ba	ND	
Fe	1.6±	.2	Pb	9389.4±	1338.1

ND - Not Detected

ENRICHMENT FACTORS RELATIVE TO EARTH CRUSTAL ABUNDANCES

NORMALIZING ELEMENT: Si

1983.02.23 ORANGEVILLE

ELEMENT	ENRICHMENT FACTOR		ELEMENT	ENRICHMENT FACTOR	
Al	2.5±	.3	Ni	ND	
Si	1.0±	.1	Cu	51.2±	32.2
P	25.1±	7.1	Zn	ND	
S	3321.6±	231.2	As	ND	
Cl	181.5±	50.7	Se	ND	
K	1.7±	.4	Br	1103.7±	685.6
Ca	7.7±	.5	Rb	ND	
Ti	ND		Sr	ND	
V	ND		Zr	ND	
Cr	ND		Cd	125143.7±	85983.1
Mn	2.2±	.2	Ba	755.6±	252.8
Fe	1.6±	.1	Pb	1230.9±	508.4

ND - Not Detected

ENRICHMENT FACTORS RELATIVE TO EARTH CRUSTAL ABUNDANCES

NORMALIZING ELEMENT: Si

1983.02.24 ORANGEVILLE

ELEMENT	ENRICHMENT FACTOR		ELEMENT	ENRICHMENT FACTOR	
Al	2.2±	.3	Ni	ND	
Si	1.0±	.1	Cu	ND	
P	20.1±	5.4	Zn	259.3±	41.7
S	2700.8±	231.5	As	5539.9±	2961.0
Cl	332.5±	144.7	Se	ND	
K	1.9±	.5	Br	ND	
Ca	8.1±	.5	Rb	ND	
Ti	ND		Sr	ND	
V	ND		Zr	ND	
Cr	ND		Cd	ND	
Mn	ND		Ba	ND	
Fe	.9±	.2	Pb	1452.9±	733.8

ND - Not Detected

ENRICHMENT FACTORS RELATIVE TO EARTH CRUSTAL ABUNDANCES

NORMALIZING ELEMENT: Si

1983.02.25 ORANGEVILLE

ELEMENT	ENRICHMENT FACTOR		ELEMENT	ENRICHMENT FACTOR	
Al	2.1±	.2	Ni	17.1±	12.5
Si	1.0±	.1	Cu	45.9±	20.8
P	13.1±	3.1	Zn	384.3±	40.4
S	2085.9±	144.3	As	4968.6±	1636.5
Cl	179.2±	33.8	Se	ND	
K	1.5±	.3	Br	1206.2±	435.9
Ca	7.8±	.4	Rb	ND	
Ti	.7±	.1	Sr	ND	
V	ND		Zr	193.1±	129.7
Cr	ND		Cd	ND	
Mn	1.3±	.5	Ba	ND	
Fe	.8±	.1	Pb	2496.5±	598.7

ND - Not Detected

ENRICHMENT FACTORS RELATIVE TO EARTH CRUSTAL ABUNDANCES

NORMALIZING ELEMENT: Si

1983.02.14 DORSET

ELEMENT	ENRICHMENT FACTOR		ELEMENT	ENRICHMENT FACTOR	
Al	17.0±	.9	Ni	32.9±	20.1
Si	1.0±	.1	Cu	56.3±	19.7
P	68.7±	14.2	Zn	195.9±	29.9
S	7789.4±	425.5	As	1778.0±	990.0
Cl	126.3±	27.6	Se	72606.0±	14521.2
K	2.1±	.2	Br	2179.1±	645.6
Ca	.9±	.1	Rb	ND	
Ti	5.0±	.4	Sr	8.0±	3.7
V	20.0±	3.9	Zr	104.3±	56.8
Cr	39.3±	9.4	Cd	54892.1±	37056.7
Mn	4.9±	.9	Ba	189.0±	103.3
Fe	1.1±	.1	Pb	2562.0±	488.7

ND - Not Detected

ENRICHMENT FACTORS RELATIVE TO EARTH CRUSTAL ABUNDANCES

NORMALIZING ELEMENT: Si

1983.02.15 OUTSET

ELEMENT	ENRICHMENT FACTOR		ELEMENT	ENRICHMENT FACTOR	
Al	145.5±	9.0	Ni	395.2±	132.0
Si	1.0±	.3	Cu	ND	
P	615.9±	147.4	Zn	6512.9±	980.2
S	66076.4±	4293.9	As	69525.6±	3495.7
Cl	ND		Se	648728.5±	309237.2
K	9.2±	2.6	Br	21315.4±	1019.3
Ca	ND		Rb	ND	
Ti	35.7±	4.5	Sr	ND	
V	ND		Zr	ND	
Cr	ND		Ca	1450474.1±	79507
Mn	ND		Ba	6627.5±	3319.0
Fe	3.4±	.8	Pb	55559.0±	8685.2

ND - Not Detected

ENRICHMENT FACTORS RELATIVE TO EARTH CRUSTAL ABUNDANCES

NORMALIZING ELEMENT: Si

1983.02.16 DORSET

ELEMENT	ENRICHMENT FACTOR		ELEMENT	ENRICHMENT FACTOR	
Al	7.6±	.5	Ni	40.2±	14.7
Si	1.0±	.1	Cu	38.3±	24.5
P	76.6±	15.9	Zn	189.3±	35.6
S	8654.2±	476.6	As	2144.6±	1176.9
Cl	206.5±	33.9	Se	90139.5±	18515.1
K	1.5±	.2	Br	2306.6±	469.0
Ca	1.3±	.1	Rb	ND	
Ti	1.7±	.3	Sr	ND	
V	13.8±	3.8	Zr	164.9±	73.5
Cr	ND		Cd	108898.2±	58590.6
Mn	4.4±	1.0	Ba	279.4±	128.7
Fe	1.0±	.1	Pb	2140.0±	352.2

ND - Not Detected

ENRICHMENT FACTORS RELATIVE TO EARTH CRUSTAL ABUNDANCES

NORMALIZING ELEMENT: Si

1983.02.17 DuSet

ELEMENT	ENRICHMENT FACTOR		ELEMENT	ENRICHMENT FACTOR	
Al	19.6±	1.1	Ni	57.9±	27.9
Si	1.0±	.1	Cu	ND	
P	84.1±	18.2	Zn	ND	
S	10001.9±	583.8	As	ND	
Cl	165.0±	58.0	Se	157208.0±	35397.0
K	.9±	.2	Br	3210.7±	839.4
Ca	1.1±	.1	Rb	86.9±	50.8
Ti	3.2±	.6	Sr	28.5±	14.3
V	31.8±	7.8	Zr	606.1±	145.3
Cr	23.1±	10.8	Cd	361913.5±	196866.9
Mn	9.4±	2.1	Ba	771.1±	530.3
Fe	1.3±	.1	Pb	3133.0±	646.2

ND - Not Detected

ENRICHMENT FACTORS RELATIVE TO EARTH CRUSTAL ABUNDANCES

NORMALIZING ELEMENT: Si

1983.02.18 DORSET

ELEMENT	ENRICHMENT FACTOR		ELEMENT	ENRICHMENT FACTOR	
Al	15.3±	1.0	Ni	ND	
Si	1.0±	.1	Cu	ND	
P	42.3±	12.8	Zn	108.1±	44.1
S	4491.8±	361.7	As	ND	
Cl	602.1±	104.5	Se	123249.7±	53516.3
K	.8±	.3	Br	2994.4±	1401.6
Ca	4.4±	.4	Rb	ND	
Ti	.8±	.4	Sr	18.6±	12.3
V	ND		Zr	818.6±	241.6
Cr	ND		Cd	ND	
Mn	ND		Ba	1459.2±	896.6
Fe	.9±	.2	Pb	2930.7±	1019.4

ND = Not Detected

ENRICHMENT FACTORS RELATIVE TO EARTH CRUSTAL ABUNDANCES

NORMALIZING ELEMENT: Si

1983.02.21 DORSET

ELEMENT	ENRICHMENT FACTOR	ELEMENT	ENRICHMENT FACTOR
Al	26.9± 2.0	Ni	205.2± 114.3
Si	1.0± .1	Cu	ND
P	180.3± 45.8	Zn	271.7± 110.4
S	16660.8± 1185.0	As	ND
Cl	566.8± 224.0	Se	538049.2±144354.7
K	1.7± .9	Br	6960.0± 3522.9
Ca	ND	Rb	295.2± 122.2
Ti	8.0± 1.3	Sr	ND
V	76.5± 29.3	Zr	2576.0± 618.3
Cr	134.1± 50.6	Cd	684729.0±400000.1
Mn	17.6± 4.9	Ba	9783.8± 2361.2
Fe	2.3± .5	Pb	13421.5± 2784.0

ND - Not Detected

ENRICHMENT FACTORS RELATIVE TO EARTH CRUSTAL ABUNDANCES

NORMALIZING ELEMENT: Si

1983.02.22 DORSET

ELEMENT	ENRICHMENT FACTOR		ELEMENT	ENRICHMENT FACTOR	
Al	75.0±	4.3	Ni	154.9±	86.3
Si	1.0±	.1	Cu	455.6±	156.9
P	157.3±	37.4	Zn	755.5±	209.1
S	15563.9±	1044.8	As	ND	
Cl	524.3±	174.8	Se	448951.5±	112237.9
K	3.7±	1.2	Br	9049.2±	4846.3
Ca	1.9±	.4	Rb	149.5±	81.4
Ti	23.0±	2.4	Sr	47.9±	25.5
V	70.1±	25.8	Zr	2469.9±	470.6
Cr	172.6±	41.5	Cd	534780.6±	355695.1
Mn	9.1±	3.5	Ba	3207.1±	1709.9
Fe	1.7±	.4	Pb	10556.5±	2088.0

ND - Not Detected

ENRICHMENT FACTORS RELATIVE TO EARTH CRUSTAL ABUNDANCES

NORMALIZING ELEMENT: Si

1983.02.23 DORSET

ELEMENT	ENRICHMENT FACTOR		ELEMENT	ENRICHMENT FACTOR	
Al	42.6±	2.6	Ni	ND	
Si	1.0+	.1	Cu	ND	
P	95.9±	26.0	Zn	122.0+	76.0
S	9508.1+	726.6	As	ND	
Cl	301.2±	154.3	Se	295282.6+	96410.8
K	1.1±	.6	Br	3787.9+	2367.4
Ca	.6+	.3	Rb	ND	
Ti	9.3±	1.6	Sr	43.3+	24.0
V	ND		Zr	1512.7+	425.0
Cr	63.6±	33.3	Cd	652157.2+	289093.6
Mn	ND		Ba	2152.2+	800.0
Fe	1.2±	.3	Pb	4652.0+	1775.6

ND - Not Detected

ENRICHMENT FACTORS RELATIVE TO EARTH CRUSTAL ABUNDANCES

NORMALIZING ELEMENT: Si

1983.02.24

DORSET

ELEMENT	ENRICHMENT FACTOR		ELEMENT	ENRICHMENT FACTOR	
Al	79.1±	4.3	Ni	123.1±	68.4
Si	1.0±	.1	Cu	298.5±	123.6
P	71.5±	20.4	Zn	283.8±	155.1
S	6149.4±	520.2	As	ND	
Cl	1163.9±	302.0	Se	301103.4±	86758.6
K	7.5±	.8	Br	2756.8±	2055.0
Ca	.8±	.3	Rb	155.4±	72.7
Ti	26.0±	1.9	Sr	35.1±	20.3
V	57.0±	21.9	Zr	1244.6±	367.7
Cr	101.3±	30.8	Cd	ND	
Mn	13.7±	5.0	Ba	ND	
Fe	1.7±	.3	Pb	5503.5±	1593.9

ND - Not Detected

ENRICHMENT FACTORS RELATIVE TO EARTH CRUSTAL ABUNDANCES

NORMALIZING ELEMENT: Si

1983.02.25

DORSET

ELEMENT	ENRICHMENT FACTOR		ELEMENT	ENRICHMENT FACTOR	
Al	12.4±	.7	Ni	ND	
Si	1.0±	.1	Cu	ND	
P	31.4±	7.7	Zn	682.8±	70.2
S	2980.1±	212.3	As	3963.8±	2563.5
Cl	192.0±	44.1	Se	73135.8±	24881.3
K	1.8±	.3	Br	2562.2±	666.5
Ca	.7±	.1	Rb	36.8±	19.0
Ti	4.0±	.5	Sr	ND	
V	14.0±	5.6	Zr	392.1±	109.3
Cr	ND		Cd	70284.6±	69793.9
Mn	3.6±	.9	Ba	ND	
Fe	1.1±	.1	Pb	5980.6±	968.1

ND - Not Detected

ENRICHMENT FACTORS RELATIVE TO EARTH CRUSTAL ABUNDANCES

NORMALIZING ELEMENT: Si

1983.02.14 WINCHESTER

ELEMENT	ENRICHMENT FACTOR		ELEMENT	ENRICHMENT FACTOR	
Al	4.1±	.2	Ni	16.5±	5.9
Si	1.0±	.1	Cu	46.1±	18.4
P	40.5±	8.3	Zn	217.8±	23.6
S	4514.3±	246.0	As	ND	
Cl	279.0±	25.2	Se	28866.9±	8898.8
K	1.9±	.2	Br	2421.8±	422.3
Ca	1.4±	.1	Rb	16.2±	6.7
Ti	1.1±	.2	Sr	ND	
V	14.5±	3.6	Zr	53.0±	29.2
Cr	11.3±	3.1	Cd	ND	
Mn	2.2±	.3	Ba	130.1±	70.5
Fe	1.1±	.1	Pb	2076.2±	301.7

ND - Not Detected

ENRICHMENT FACTORS RELATIVE TO EARTH CRUSTAL ABUNDANCES

NORMALIZING ELEMENT: Si

1983.02.15 WINCHESTER

ELEMENT	ENRICHMENT FACTOR		ELEMENT	ENRICHMENT FACTOR	
Al	119.6±	6.1	Ni	50.3±	24.2
Si	1.0±	.1	Cu	344.1±	47.0
P	81.7±	16.7	Zn	104.3±	31.7
S	9298.5±	530.4	As	3104.6±	1949.8
Cl	350.8±	125.7	Se	50745.2±	30808.4
K	4.2±	.4	Br	10126.7±	1025.7
Ca	1.9±	.2	Rb	43.1±	24.2
Ti	4.5±	.4	Sr	ND	
V	80.5±	9.6	Zr	ND	
Cr	78.4±	12.6	Cd	174298.9±	93216.8
Mn	8.8±	1.2	Ba	501.2±	256.9
Fe	.8±	.1	Pb	8222.7±	745.4

ND - Not Detected

ENRICHMENT FACTORS RELATIVE TO EARTH CRUSTAL ABUNDANCES

NORMALIZING ELEMENT: Si

1983.02.16 WINCHESTER

ELEMENT	ENRICHMENT FACTOR		ELEMENT	ENRICHMENT FACTOR	
Al	2.5±	.2	Ni	47.5±	9.7
Si	1.0±	.1	Cu	51.1±	13.7
P	31.1±	6.4	Zn	241.5±	18.8
S	2720.8±	150.6	As	ND	
Cl	1414.9±	77.7	Se	13256.6±	6069.3
K	2.6±	.2	Br	2736.7±	341.8
Ca	4.2±	.2	Rb	12.5±	4.8
Ti	1.9±	.2	Sr	ND	
V	78.5±	5.9	Zr	59.8±	41.9
Cr	10.7±	4.2	Cd	ND	
Mn	9.2±	.7	Ba	ND	
Fe	1.1±	.1	Pb	3065.9±	277.9

ND - Not Detected

ENRICHMENT FACTORS RELATIVE TO EARTH CRUSTAL ABUNDANCES

NORMALIZING ELEMENT: Si

1983.02.17 WINCHESTER

ELEMENT	ENRICHMENT FACTOR		ELEMENT	ENRICHMENT FACTOR	
Al	6.1±	.4	Ni	69.0±	25.0
Si	1.0±	.1	Cu	147.0±	60.4
P	92.4±	19.6	Zn	269.7±	48.5
S	10147.9±	574.3	As	ND	
Cl	ND		Se	ND	
K	3.5±	.4	Br	4103.4±	752.1
Ca	1.7±	.2	Rb	44.6±	21.0
Ti	.6±	.2	Sr	ND	
V	44.0±	7.1	Zr	532.9±	196.5
Cr	20.4±	9.2	Cd	ND	
Mn	4.9±	.9	Ba	264.6±	227.1
Fe	1.2±	.1	Pb	5392.9±	604.0

ND - Not Detected

ENRICHMENT FACTORS RELATIVE TO EARTH CRUSTAL ABUNDANCES

NORMALIZING ELEMENT: Si

1983.02.18 WINCHESTER

ELEMENT	ENRICHMENT FACTOR		ELEMENT	ENRICHMENT FACTOR	
Al	2.7±	.2	Ni	27.3±	9.5
Si	1.0±	.1	Cu	13.1±	7.0
P	17.8±	3.8	Zn	159.2±	15.7
S	1104.1±	69.6	As	ND	
Cl	2277.5±	132.3	Se	8808.9±	6342.4
K	2.2±	.2	Br	2087.3±	336.5
Ca	4.8±	.3	Rb	ND	
Ti	1.2±	.1	Sr	1.9±	1.7
V	20.8±	3.4	Zr	75.5±	26.1
Cr	4.9±	2.2	Cd	ND	
Mn	7.1±	.6	Ba	ND	
Fe	.9±	.1	Pb	2035.7±	240.0

ND = Not Detected

ENRICHMENT FACTORS RELATIVE TO EARTH CRUSTAL ABUNDANCES

NORMALIZING ELEMENT: Si

1983.02.21

ELEMENT	ENRICHMENT FACTOR		ELEMENT	ENRICHMENT FACTOR	
Al	33.8	1.7	Ni	49.5	3.3
Si	1.0	.1	Cu	154.0	25.4
P	44.1	9.5	Zn	249.3	23.7
S	4061.3	242.3	As	ND	
Cl	1101.5	109.7	Se	ND	
K	2.9	.3	Br	3283.9	483.6
Ca	2.8	.2	Rb	22.4	1.7
Ti	2.0	.3	Sr	ND	
V	22.6	4.3	Zr	416.4	121.1
Cr	38.6	6.8	Ce	ND	
Mn	3.0	.6	Ba	423.6	143.2
Fe	1.1	.1	Pb	3296.4	357.7

ND = Not Detected

ENRICHMENT FACTORS RELATIVE TO EARTH CRUSTAL ABUNDANCES

NORMALIZING ELEMENT: Si

1983.02.22 WINCHESTER

ELEMENT	ENRICHMENT FACTOR		ELEMENT	ENRICHMENT FACTOR	
Al	20.5±	1.0	Ni	25.7±	7.7
Si	1.0±	.1	Cu	30.4±	9.5
P	15.8±	3.4	Zn	106.5±	11.7
S	1394.6±	81.9	As	ND	
Cl	418.3±	37.5	Se	ND	
K	2.1±	.2	Br	1445.0±	262.3
Ca	2.3±	.1	Rb	6.8±	4.1
Ti	1.4±	.1	Sr	ND	
V	16.6±	1.9	Zr	102.4±	36.9
Cr	20.4±	2.5	Cd	ND	
Mn	12.2±	.8	Ba	43.9±	38.0
Fe	.6±	.0	Pb	1447.5±	194.1

ND - Not Detected

ENRICHMENT FACTORS RELATIVE TO EARTH CRUSTAL ABUNDANCES

NORMALIZING ELEMENT: Si

1983.02.23 MANCHESTER

ELEMENT	ENRICHMENT FACTOR		ELEMENT	ENRICHMENT FACTOR	
Al	24.4±	1.3	Ni	160.2±	57.4
Si	1.0±	.1	Cu	229.3±	87.4
P	71.0±	14.8	Zn	175.5±	38.1
S	7292.9±	415.3	As	ND	
Cl	ND		Se	ND	
K	4.4±	.5	Br	7743.4±	1058.1
Ca	1.2±	.2	Rb	63.6±	30.9
Ti	1.4±	.3	Sr	19.0±	10.1
V	73.7±	10.7	Zr	457.1±	278.8
Cr	44.5±	13.9	Cd	ND	
Mn	9.6±	1.4	Ba	423.7±	323.2
Fe	1.1±	.1	Pb	7620.1±	851.5

ND - Not Detected

ENRICHMENT FACTORS RELATIVE TO EARTH CRUSTAL ABUNDANCES

NORMALIZING ELEMENT: Si

1983.02.24 WINCHESTER

ELEMENT	ENRICHMENT FACTOR		ELEMENT	ENRICHMENT FACTOR	
Al	7.4±	.4	Ni	52.7±	18.3
Si	1.0±	.1	Cu	57.7±	27.0
P	19.2±	4.5	Zn	204.8±	25.7
S	1672.3±	111.2	As	ND	
Cl	1245.8±	96.9	Se	ND	
K	2.4±	.2	Br	2054.6±	345.8
Ca	4.7±	.3	Rb	ND	
Ti	1.4±	.2	Sr	ND	
V	28.8±	5.7	Zr	133.9±	44.2
Cr	13.9±	4.3	Cd	ND	
Mn	3.2±	.8	Ba	ND	
Fe	.7±	.1	Pb	2926.2±	442.0

ND - Not Detected

ENRICHMENT FACTORS RELATIVE TO EARTH CRUSTAL ABUNDANCES

NORMALIZING ELEMENT: Si

1983.02.25 WINCHESTER

ELEMENT	ENRICHMENT FACTOR		ELEMENT	ENRICHMENT FACTOR	
Al	3.4±	.2	Ni	12.8±	9.7
Si	1.0±	.1	Cu	57.3±	27.3
P	20.6±	4.8	Zn	50.0±	12.2
S	1416.7±	99.3	As	ND	
Cl	490.9±	40.4	Se	ND	
K	2.1±	.2	Br	2381.3±	361.0
Ca	3.7±	.2	Rb	19.9±	10.1
Ti	1.0±	.2	Sr	ND	
V	16.1±	3.2	Zr	132.0±	44.1
Cr	8.5±	4.3	Cd	ND	
Mn	2.1±	.4	Ba	ND	
Fe	.6±	.1	Pb	2594.8±	436.3

ND - Not Detected

ENRICHMENT FACTORS RELATIVE TO EARTH CRUSTAL ABUNDANCES

NORMALIZING ELEMENT: Si

1983.02.14 MISSISSAGI

ELEMENT	ENRICHMENT FACTOR		ELEMENT	ENRICHMENT FACTOR	
Al	3.3±	.3	Ni	ND	
Si	1.0±	.1	Cu	ND	
P	74.7±	16.0	Zn	283.1±	56.7
S	9325.6±	534.1	As	ND	
Cl	ND		Se	ND	
K	3.5±	.4	Br	1415.0±	731.9
Ca	.7±	.1	Rb	36.5±	23.6
Ti	1.2±	.4	Sr	ND	
V	ND		Zr	ND	
Cr	ND		Cd	149379.5±	76274.9
Mn	ND		Ba	330.3±	247.8
Fe	.9±	.1	Pb	1895.1±	910.9

ND - Not Detected

ENRICHMENT FACTORS RELATIVE TO EARTH CRUSTAL ABUNDANCES

NORMALIZING ELEMENT: Si

1983.02.15 MIS815SAGI

ELEMENT	ENRICHMENT FACTOR		ELEMENT	ENRICHMENT FACTOR	
Al	8.1±	.9	Ni	ND	
Si	1.0±	.1	Cu	ND	
P	25.0±	8.9	Zn	ND	
S	6178.8±	502.4	As	10978.7±	6546.3
Cl	ND		Se	ND	
K	1.2±	.5	Br	ND	
Ca	ND		Rb	ND	
Ti	4.4±	.7	Sr	ND	
V	ND		Zr	ND	
Cr	ND		Cd	755242.4±	234367.1
Mn	ND		Ba	2166.8±	1359.2
Fe	.2±	.1	Pb	ND	

ND - Not Detected

ENRICHMENT FACTORS RELATIVE TO EARTH CRUSTAL ABUNDANCES

NORMALIZING ELEMENT: Si

1983.02.17 MISSISSAGI

ELEMENT	ENRICHMENT FACTOR		ELEMENT	ENRICHMENT FACTOR	
Al	5.8±	1.0	Ni	ND	
Si	1.0±	.2	Cu	ND	
P	59.0±	16.1	Zn	985.5±	226.5
S	10328.4±	794.2	As	ND	
Cl	345.4±	235.7	Se	ND	
K	4.7±	.8	Br	ND	
Ca	.5±	.2	Rb	ND	
Ti	1.9±	.8	Sr	ND	
V	ND		Zr	ND	
Cr	ND		Cd	ND	
Mn	ND		Ba	1752.3±	1086.8
Fe	ND		Pb	2467.6±	1798.0

ND - Not Detected

ENRICHMENT FACTORS RELATIVE TO EARTH CRUSTAL ABUNDANCES

NORMALIZING ELEMENT: Si

1983.02.18 MISSISSAGI

ELEMENT	ENRICHMENT FACTOR		ELEMENT	ENRICHMENT FACTOR	
Al	1.6±	.2	Ni	ND	
Si	1.0±	.1	Cu	ND	
P	35.5±	10.5	Zn	68.8±	39.6
S	2117.4±	217.3	As	ND	
Cl	153.3±	81.7	Se	67044.9±	46639.9
K	.9±	.4	Br	5029.2±	2089.2
Ca	2.3±	.2	Rb	75.7±	38.3
Ti	1.4±	.3	Sr	ND	
V	ND		Zr	189.2±	178.4
Cr	93.8±	18.3	Ca	349930.6±	124412.5
Mn	3.5±	1.3	Ba	2579.6±	745.3
Fe	1.0±	.1	Pb	5090.4±	1510.7

ND - Not Detected

ENRICHMENT FACTORS RELATIVE TO EARTH CRUSTAL ABUNDANCES

NORMALIZING ELEMENT: Si

1983.02.21 MISSISSAGI

ELEMENT	ENRICHMENT FACTOR		ELEMENT	ENRICHMENT FACTOR	
Al	5.1±	.7	Ni	ND	
Si	1.0±	.1	Cu	ND	
P	63.1±	17.7	Zn	ND	
S	7471.5±	549.2	As	ND	
Cl	ND		Se	ND	
K	3.2±	.5	Br	1746.9±	1629.0
Ca	.4±	.1	Rb	145.5±	64.0
Ti	1.5±	.5	Sr	ND	
V	ND		Zr	ND	
Cr	ND		Cd	680150.7±	206826.5
Mn	ND		Ba	619.8±	584.6
Fe	.4±	.1	Pb	3765.3±	2358.9

ND - Not Detected

ENRICHMENT FACTORS RELATIVE TO EARTH CRUSTAL ABUNDANCES

NORMALIZING ELEMENT: Si

1983.02.22 MISSISSAGI

ELEMENT	ENRICHMENT FACTOR		ELEMENT	ENRICHMENT FACTOR	
Al	1.4±	.6	Ni	ND	
Si	1.0±	.2	Cu	ND	
P	114.5±	33.5	Zn	168.2±	143.2
S	11090.1±	933.8	As	ND	
Cl	ND		Se	251475.3±	143700.2
K	4.5±	.9	Br	ND	
Ca	ND		Rb	ND	
Ti	5.0±	1.9	Sr	ND	
V	ND		Zr	2054.0±	1248.4
Cr	ND		Cd	ND	
Mn	ND		Ba	5436.8±	2467.8
Fe	2.4±	.3	Pb	7286.0±	2416.9

ND - Not Detected

ENRICHMENT FACTORS RELATIVE TO EARTH CRUSTAL ABUNDANCES

NORMALIZING ELEMENT: Si

1983.02.23 MISSISSAGI

ELEMENT	ENRICHMENT FACTOR		ELEMENT	ENRICHMENT FACTOR	
Al	5.2±	.6	Ni	ND	
Si	1.0±	.1	Cu	ND	
P	75.4±	18.7	Zn	ND	
S	6970.7±	505.1	As	ND	
Cl	127.6±	126.8	Se	152686.1±	70153.1
K	1.5±	.4	Br	ND	
Ca	.3±	.1	Rb	86.4±	54.2
Ti	3.0±	.9	Sr	ND	
V	ND		Zr	756.7±	514.5
Cr	56.1±	20.6	Cd	563697.0±	181230.1
Mn	ND		Ba	1612.3±	1029.0
Fe	.7±	.2	Pb	4219.1±	2065.6

ND - Not Detected

ENRICHMENT FACTORS RELATIVE TO EARTH CRUSTAL ABUNDANCES

NORMALIZING ELEMENT: Si

1983.02.24 MISSISSAGI

ELEMENT	ENRICHMENT FACTOR		ELEMENT	ENRICHMENT FACTOR	
Al	2.2±	1.0	Ni	ND	
Si	1.0±	.2	Cu	ND	
P	95.2±	29.8	Zn	ND	
S	7856.6±	577.0	As	ND	
Cl	ND		Se	ND	
K	1.5±	.7	Br	6748.4±	3640.6
Ca	ND		Rb	ND	
Ti	3.0±	1.0	Sr	ND	
V	ND		Zr	1196.0±	571.9
Cr	ND		Cd	ND	
Mn	ND		Ba	2967.4±	1271.3
Fe	1.6±	.3	Pb	3935.7±	2175.9

ND - Not Detected

ENRICHMENT FACTORS RELATIVE TO EARTH CRUSTAL ABUNDANCES

NORMALIZING ELEMENT: Si

1983.02.25 MISSISSAGI

ELEMENT	ENRICHMENT FACTOR		ELEMENT	ENRICHMENT FACTOR	
Al	1.0	± .3	Ni	ND	
Si	1.0	± .1	Cu	ND	
P	18.6	± 7.0	Zn	ND	
S	1693.0	± 135.5	As	ND	
Cl	ND		Se	ND	
K	1.0	± .2	Br	ND	
Ca	.2	± .1	Rb	ND	
Ti	.5	± .3	Sr	ND	
V	ND		Zr	ND	
Cr	ND		Cd	333785.6	± 110889.4
Mn	ND		Ba	579.2	± 346.7
Fe	.8	± .1	Pb	2098.1	± 636.4

ND -- Not Detected

POOR

QUALITY

ORIGINAL